

# APPLICATION PROPAGATION ENVIRONMENT (APEX)

Project Management Plan

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# 1 INTRODUCTION

This document represents the Project Management Plan (PMP) for the Application Propagation Environment (APEX) project. It serves as a comprehensive guide outlining the strategies, methodologies, and frameworks that will be employed throughout the lifecycle of the project. The PMP offers stakeholders, team members, and other relevant parties a clear understanding of the project's objectives, structure, management approach, risks, milestones, deliverables, work breakdown, and schedule.

Throughout this document, detailed information on the structure of the organization is provided, including the consortium involved, team organization, and personnel allocation. Additionally, the management approach adopted for this project will be explained, emphasizing the methodologies and principles guiding the project's execution.

This document will also describe the identification and management of risks through a comprehensive risk register. Milestones and meetings will be outlined to ensure transparent communication and accountability among all stakeholders. Deliverables will be clearly defined, for both the phase-in and the operational phase of the project.

In addition, a detailed work breakdown will be provided, along with descriptions of work packages. Finally, the schedule will be presented, delineating timelines and dependencies to ensure timely completion of project tasks and milestones.

## 2 STRUCTURE OF THE ORGANIZATION

### 2.1 Consortium

The APEx consortium is comprised of leading experts in various domains. These experts specialize in EO platform service development, application interoperability, front-end development, cloud engineering, and source code analysis and optimization. The bidding consortium includes the following partners:

#### 2.1.1 VITO

As prime contractor of the APEx project, building on their experience in leading several ESA projects, VITO has the responsibility for the following key roles:

- General Project Management
- Leading the system and architecture design
- Establishment of the main APEx portal
- Creation of the APEx documentation
- Development and operation of the Project Portal and Catalogue service
- Contribution to the Algorithm Hosting and Upscaling services
- Onboarding of projects onto the APEx
- Onboarding of the APEx services on the Network of Resources
- Communication & Outreach

#### 2.1.2 Terradue

Drawing from their expertise in cloud services and Earth sciences applications, during the project, Terradue is responsible for:

- Leading the development and operation of the Instantiation Services,
- Leading the development and operation of the Interactive Development Environments and User Workspace
- Leading the development and operation of the Algorithm Hosting Service and Algorithm Upscaling Service
- Contributing to the overall software architecture
- Contributing to the business model development
- Contributing to the APEx user communication and outreach

#### 2.1.3 Brockmann Consult

The company combines the thematic expertise of a value adder with excellent software engineering experience and a highly skilled team. This combination of expertise is used in the APEx for:

- Leading the algorithm enhancement service
- Leading the toolbox cloudification service
- Leading the algorithm intercomparison service



- Contributing to the overall software architecture
- Contributing to the business model development
- Contributing to the APEX user communication and outreach

#### 2.1.4 Sparkgeo Consulting Inc.

Sparkgeo is responsible for leading the Geospatial Explorer service including:

- Development of a web-based dashboard solution, supporting an interactive visualisation environment for EO Data and derived products
- Geospatial Explorer instantiation
- Mechanisms for dashboard configuration (content, front-end look and feel etc)
- Successful instantiation of the Geospatial Explorer for four SEF thematic areas and up to 20 application projects
- Functional enhancements to Geospatial Explorer capabilities
- Testing and security of Geospatial Explorer capability

#### 2.1.5 Inuits

Inuits is responsible for the infrastructure:

- Setup of the base infrastructure that will be used to continuously build and deploy the APEX service instances.
- Set up a user management system that can be used throughout the APEX portal. This includes setting up the integration with the ESA EOIAM identity management system.
- Collection of metrics and provide an operations dashboard to monitor health, availability, and usage of APEX compliant on-demand algorithms/workflows and report their statistics. This includes the metrics of the instantiation and propagation services.
- Enhancements to the existing dashboards, including more APEX related services.
- Apply improvements to the existing infrastructure.
- Operations of the existing platform.
- Apply enhancements to the user forum service.
- Apply enhancements to the documentation service.

## 2.2 Team Organization

The roles and responsibilities for the APEX project are defined as follows:

- The **Contract Officer** (Dennis Clarijs, VITO) manages the contractual and financial aspects of the project. As such he will be the main point of contact concerning all contractual matters.
- The **Project Manager** (Bram Janssen, VITO) sets up the control and monitoring of the project in agreement with the Project Management Plan. He is responsible for all technical and management aspects of APEX. The role of VITO Project manager is assigned to a VITO Project coordinator.
- The **EO Platform Service Development lead** (Jeroen Dries, VITO) will be the technical development lead of APEX, responsible for leading the design of the base platform and

overseeing the main developments of the different services, ensuring their seamless integration into the APEx framework.

- The **EO Application Interoperability Lead** (Pedro Goncalves, Terradue) will be ensuring the seamless integration of EO applications within the APEx framework, drawing upon his experience in addressing interoperability challenges in Earth Observation and cloud computing.
- The **Front-end Lead (Geospatial Explorer)** (Adam Tweedie, SparkGEO). Adam is an experienced JavaScript front-end developer (previously leading teams at the BBC) who will be taking ownership of the development of the Geospatial Explorer.
- The **Cloud Architect** (Jan Collijs, Inuits) Jan is a very experienced Linux and open-source specialist with a good listening ear. He can combine his broad technical skills with analytical and problem-solving thinking to always achieve the best solution.
- The **DevOps Expert** (Zdenek Jurman, Inuits) Mikulas, a seasoned professional at Inuits, specialises in container management with a focus on Kubernetes and open-source technologies. With a knack for designing scalable solutions and ensuring robust infrastructure, Mikulas excels in troubleshooting complex systems to enhance performance and reliability.
- The **Source Code Analysis and Optimisation Lead** (Martin Böttcher, Brockmann Consult) holds a Ph.D. in informatics and has many years of experience in developing and operationalising algorithms for EO data processing. He will be responsible for application-oriented services, namely algorithm enhancement, toolbox cloudification and algorithm intercomparison.
- The **Communications Manager** (Evelyn Stynen, VITO) will be responsible for planning, coordinating, and facilitating communication with the APEx user community, which includes EOP R&D projects and external users. Additionally, the Communications Manager will actively engage with and promote activities within the wider EO community. Furthermore, they will support communication with ESA delegate bodies to ensure effective communication throughout the project.

## 2.3 Personnel

### 2.3.1 Key Personnel

Table 1. Key Personnel

Key Individual / Company	Role in organization	Role on project	Location	Working Time on project
Bram Janssen (VITO)	Project Manager	Project Manager	BE	1311h
Jeroen Dries (VITO)	OpenEO Technical Lead	Technical Lead	BE	1109h
Evelyn Stynen (VITO)	Marketing & Communication	Communication Manager	BE	1251h
Pedro Goncalves (Terradue)	Strategy and Int. Relations	Earth Observation Application Interoperability Lead	IT	480h
Fabio Zingaretti (Terradue)	Technical Service Manager	Platform Engineer	IT	1240h
Martin Böttcher (Brockmann Consult)	Software Engineer	Lead algorithm and toolbox enhancements	DE	480h
Adam Tweedie (Sparkgeo)	Senior Front End Developer	Geospatial Explorer Development Lead	UK	1344h
Zdenek Jurman (Inuits)	DevOps Expert	DevOps Expert	CZ	3403h

### 2.3.2 Additional Personnel

Table 2. Additional Personnel

Key Individual / Company	Project involvement	Project Role	Location
Dennis Clarijs (VITO)	Project Management	VITO Solution Provider Back-up Project Manager	BE
Pratichhya Sharma (VITO)	Propagation services	openEO service expert	BE

	Communication		
Stijn Caerts (VITO)	System design, Instantiation services APEX Portal	IT expert	BE
Mauro Arcorace (Terradue)	Algorithm Upscaling Service	User Community Coordinator	IT
Simone Vaccari (Terradue)	Interactive Development Environments Algorithm Hosting Service	Geospatial Expert	IT
Olaf Danne (Brockmann Consult)	Propagation services	Scientific Processor Analyst and Software developer	DE
Tom Block (Brockmann Consult)	Propagation services	Toolbox expert	DE
Sabine Embacher (Brockmann Consult)	Propagation services	Software developer	DE
Dan Ormsby (Sparkgeo)	System Design Instantiation services	Project Management	UK
David Dowding (Sparkgeo)	Instantiation services	Geospatial Development	UK
Justin Robinson (Sparkgeo)	Instantiation services	Front end UI Development	CA
James Banting (Sparkgeo)	Instantiation services	Geospatial Architecture	CA
Joe Burkinshaw (Sparkgeo)	Instantiation services	Geospatial Development	CA
Tina Van Hoek	System design, Instantiation services, Propagation services	Team Lead	BE
Josef Kadlecek	System design	Medior Platform Engineer	CZ
Simon Berka	System design	Medior Platform Engineer	CZ
Kris Buytaert	System design	Linux & DevOps Expert	BE
Julien Pivotto	System design	Observability & DevOps Expert	BE
Wouter D'Haeseleer	System design	DevOps Expert	BE

## 3 MANAGEMENT APPROACH

### 3.1.1 Project Management and Execution

The APEx Project Manager has executive responsibility for all project activities. He shall be the sole interface with ESA for the duration of the project. He will execute the following activities:

- Organize, monitor, and control all project activities
- Ensures that the project meets its stated objectives
- Maintain the working schedule
- Organize and coordinate the interaction between the consortium and ESA
- Ensure the overall integrity of the WPs
- Document all project management activities in the present document (PMP)
- Provide meeting agendas to the Agency, at least 1 week prior to each progress meeting
- Provide documentation to review to the Agency, at least 1 week prior to each milestone meeting
- Provide written minutes of meetings to the Agency at the end of each milestone meeting
- Notify immediately the Agency of technical problems that incur risk to the schedule
- Provide progress reports to the Agency
- Maintain a fully up-to-date Action List for the project
- Maintain a project intranet
- Identify and propose actions to recover all schedule over-runs
- Check and review all deliverables before delivery to the Agency

### 3.1.2 Management and Control Procedures

Microsoft Project will be the main planning tool. The baseline schedule is described in detail in section 8.

The schedule will be evaluated and updated as part of the progress monitoring and reporting activities as described in section 8. The critical part and risk analysis are an integral part of this monitoring and reporting process. Unless otherwise stated, VITO will retain copies of all records and reports associated with this Contract for a minimum of three years after completion of the Contract.

### 3.1.3 Document Control & Issue tracking

A Microsoft Teams environment including SharePoint will be used for document management and exchange within the consortium and towards ESA. VITO will facilitate access throughout the project and keep it well organized. A separate Teams environment will be provided by ESA to publish the final versions of the project document deliverables. To ensure partners are correctly informed on upcoming deliverable deadlines, a dedicated email will be sent to involved parties.

In terms of issue tracking, software project planning and markdown-based deliverables (such as design documentation), we propose to use a public GitHub repository. This gives the advantage that the code is available, tasks and bugs can be tracked, and communities can contribute due to the open-source nature of the project.

### **3.1.4 Progress Monitoring and Control**

The progress of the project will be monitored by assembling and interpreting the status reports of the partners that have an activity scheduled during any period. VITO will assemble the individual status reports into a project-spanning status report that will be delivered to the Agency.

Progress meetings will be organized, via teleconference, with all partners on a monthly basis to monitor the project progress. VITO will be responsible for preparing the agenda for all meetings relating to the project, no later than one week before the meeting takes place.

VITO will provide to the Agency and the participating partners, the minutes of the meetings for which VITO in its function as Prime Contractor is chairman.

The list of meetings held and planned will be added to each status report. Initially, the following meetings are planned.

These meetings can be delayed or moved forward slightly to correspond to important project milestones. Depending on the importance of the meeting, it will be held with all partners present, with some partners present or by teleconference.

The project planning will be updated regularly and included in the status reports. Potential bottlenecks and critical paths will be indicated, and corrective action will be suggested in time.

### **3.1.5 Action Item Control**

VITO will maintain an Action Item List, recording all actions that are defined during the work, during the progress meetings or identified by the Agency.

All actions will specify at least the following:

- the originator
- the responsible
- the date of creation
- the deadline for implementation,
- the status (open, closed, suspended, refused)
- a description of the action

A review of the action list will be a mandatory agenda point in every progress meeting. An updated action list will be added to the bi-monthly progress report.

### 3.1.6 Reporting

The project's progress will be communicated through the delivery of progress reports at regular intervals throughout the project's duration. These reports will vary in detail, each offering a specific level of insight into the progress of the different work packages and the project as a whole.

#### Bi-monthly Progress Report

VITO will compile bi-monthly progress reports that shall use the work package descriptions as input. The information analysed will include:

- The work effort spent on each activity
- The level of completion of the activity
- The intermediate results achieved
- The work effort required to complete the activity

The bi-monthly progress reports will comprise:

- An overview of the activities carried out during the reporting period,
- The progress made during the reporting period and the results achieved
- An up-to-date Action Item List
- An up-to-date Risk Register
- Identification of problem areas and suggestions for solutions
- A summary of the work planned during the next period.
- An updated planning clearly identifying potential bottlenecks, critical paths, or delays in the planned schedule, together with suggestions for corrective action.

Each subcontractor shall submit to VITO, the part of the progress report relating to the activities for which he was responsible during the current reporting period, and this no later than three working days before the end of each calendar month. In case of non-delivery of the contribution, the delivery of the progress report to the Agency will not be delayed. VITO will deliver the bi-monthly progress report within one week of each second calendar month for the full duration of the project.

Full visibility will be given to the Agency concerning the project's status and evolution. E-mail will be used for all communications.

#### Quarterly Progress Report

VITO will produce quarterly status reports summarizing the project's progress over the last quarter. These reports will feature a concise bullet list highlighting the project's major achievements, avoiding project-specific terminology.

VITO will be responsible for compiling these reports based on the information from the bi-monthly progress reports. Each report will not exceed 200 words and will be delivered 14 days before the end of each quarter. The final result will be delivered to the Agency by email.

## **Semestrial Progress Report**

VITO will deliver a semestrial progress report every six months in the form of a PowerPoint presentation. This presentation will focus on showcasing the primary achievements from the project's latest semester. The content of the report will be compiled based on information from the other progress reports. The final presentation will be sent to the Agency via email.

### **3.1.7 Subcontractor Management**

VITO, as prime contractor, takes responsibility for the coordination of the activities of the partners/subcontractors, i.e., the activities of VITO itself. Each company however remains responsible for parts of the work that they choose to subcontract, including local partner(s).

Timely delivery, review and approval of partner/subcontractor deliverables will be ensured through:

- Planned progress and working meetings
- Review of output from subcontractors by the VITO Project Manager before delivery to ESA
- Additional meetings when required

Formal deliverables and results of formal actions from subcontractors will be delivered to the Agency via VITO. Partners/Subcontractors shall not deliver formal items directly to the Agency without explicit approval from VITO.

### **3.1.8 Disagreement**

Any disagreement will be identified early and resolved as quickly as possible through direct discussion between the concerned parties. The Project Manager will be in charge of resolving any project management issues. These issues will be first presented to the Technical Officer of ESA together with the Contract Officer. The ESA proposed solution will then be discussed between the consortium partners. In case the problem is not solved yet, the issue will be escalated to the ESA industrial ombudsman.

If disagreements persist, they will be subject to the procedure agreed on in the contract (Clause 35 of the Draft Contract).

### **3.1.9 Quality Assurance**

As prime contractor, VITO will take the responsibility to define, verify and implement the quality management procedures for the project.

The quality management tasks include:

- Specifications for all documents
- Specification of the methods and tools to be used
- Coding standards
- Configuration management
- Monitor all system, hardware, and software problems through a System Problem Report plan



- Monitor and verify all deliverable documents
- Monitor and verify the acceptance tests
- Monitor relations with and deliveries to the customers
- Monitor and verify all software and hardware deliveries and installations

## Tools

To streamline and support quality assurance activities within the project, the consortium will utilize the following tools:

- **Microsoft Teams:** A dedicated Teams environment will be established to facilitate communication and collaboration amongst consortium partners and ESA. Different channels will be created, including a public area for publishing deliverables and a consortium working area serving as the project's working directory.
- **Microsoft SharePoint:** Linked to the Teams environment, VITO will grant ESA and consortium partners access to a SharePoint website. This website will enable stakeholders to access important project documents, such as deliverables, milestone presentations, progress reports, meeting minutes, ...
- **GitHub:** The consortium proposes GitHub for managing all software deliverables. This platform will host relevant code repositories configured according to best practices in open-source development.

## Procedures and formats

All document deliverables are prepared in the consortium's working area on Teams. Each document is initially created in a temporary format (e.g., Word) allowing consortium partners to contribute and review content collaboratively. After a final review by VITO, the document is tagged with the correct version and published as a PDF on the public Teams channel and SharePoint.

Software deliverables are managed on GitHub following best practices in open-source development. The project will implement concepts such as build pipelines and versioning changelogs to maintain a consistent and stable code base across different deliverables.

### 3.1.10 Risk Management

#### Responsibilities

The Project Manager is responsible for the overall risk management of the APEx project, including:

- Maintaining the risk register
- Reviewing risk control actions for completeness, feasibility, and adequacy
- Evaluating costs associated with risk control actions
- Performing risk status accounting
- Tracking efforts to reduce medium and high risks to acceptable levels
- Facilitating risk assessments
- Preparing risk briefings, reports, and documents as required for project reviews

## **Risk visibility and decision making**

A risk review and reporting are held at every milestone to:

- Identify and assess the risk: Risks will be identified by means of the categories defined. All details of the identified risks will be entered in the risk register. A risk owner (responsible) will be assigned for each risk. All risks will be assessed and quantified (severity and likelihood). The list of identified risks will be reviewed and completed. The results of previously decided actions will be evaluated and the risk rankings will be modified accordingly.
- Decide and propose actions: The list of risk statuses and actions will be discussed. Status modifications and additional actions are added to the list. Actions will be proposed to reduce all unacceptable risks.
- Communicate and accept: The risk lists are an essential part of the progress reports. The result of the above actions will be communicated to the appropriate level of management.

## **Risk assessment**

During the APEx Project, each team member can declare new risks. If a new risk has been identified, the Project Manager analyses the risk to isolate its cause and to determine its effects, with the help of the other team members, if needed. The Project Manager will rate the risk in terms of its probability of occurrence and its severity of impact on cost, schedule, service delivery, organisational security, and technical performance. The Project Manager will communicate the risk with the APEx Project Members via the bi-monthly progress reports and the status of the risks will be discussed during the APEx Milestone Meetings.

## Risk scoring scheme

Table 3 lists the different risk categories related to the project. These are mapped to the risk register in section 4.

*Table 3. Risk Categories*

Risk category	Risk category description
Cost	Implementation cost is higher than budget
Schedule	Full implementation not possible within schedule
Security	Full security level might not be guaranteed
Functionality	Full implementation of requirements in scope of budget / limitations might be required
Privacy	Privacy requirements cannot be met

Table 4 presents the severity level and consequences that are linked to the listed items in the risk register. Table 5 presents the likelihood, or chance that a risk is presented during the project phase. When combined, they present the risk status (listed in Table 6) and form the base for the risk management and mitigation strategy.

*Table 4. Risk severity of consequence levels*

Severity level	Severity of consequence
Critical	Leads to the termination of the entire project.
Major	Essential requirements cannot be realized and/or strong impact on the entire project.
Medium	Non-essential requirements cannot be realized and/or minimal impact on the entire project
Minor	Limited impact on the entire project.

*Table 5. Risk likelihood of occurrence levels*

Likelihood	Likelihood of consequence
High	The risk will almost certainly occur
Medium	The risk is likely to occur
Low	The risk is unlikely to occur

*Table 6. Risk Statuses*

Risk Status	Risk Status description
Unacceptable (U)	The risk is unacceptable, actions need to be decided to reduce the risk
Reduce (Rd)	Actions have been taken to ensure that the risk does not occur or the impact to the project is minimized
Move (Mv)	The responsibility of the risk is transferred to a third party
Avoid (A)	Actions have been taken to eliminate the condition causing the problem
Monitor (Mo)	Actions have been taken to monitor the risk
Leave (L)	The risk is accepted, no actions have to be undertaken
Resolved (Rs)	The risk has been resolved.

## 4 RISK REGISTER

Table 7. Risk register

Risk	Risk Severity	Risk Likelihood	Risk Category	Risk Status	Possible mitigation
Loss of key personnel	Medium	Low	Cost	Mo	The team depends primarily on the competence of the involved organisations rather than individuals. Each organization in the team can replace key personnel which have comparable competence.
Delay in deliverables	Minor	Low	Schedule	Mo	Careful, in advance planning of the different tasks and a close follow up through monthly progress reports will minimize the risk.
Conflict between project partners	Medium	Low	Schedule Functionality	Mo	VITO and partners have effective project management, communication, and conflict resolution mechanisms in place.
Project scope and schedule slips	Medium	Low	Schedule Functionality	Mo	VITO has assigned an experienced project manager (PM) with the required skills and expertise to manage projects of this complexity. Internal reporting structures and supports are in place to identify issues and provide corrective actions in a timely manner.
Low user engagement or adoption of the platform	Medium	Medium	Operational	Rd	Conduct user training sessions, gather feedback for continuous improvement, communication of APEx services benefits and advantages. Engage with ESA as attention point in upcoming tenders to make APEx services an integral part of the requirements.
Delay in provisioning NoR of services	Medium	Medium	Operational Schedule	Rd	Engage with ESA project officer responsible for NoR onboarding. This is an external dependency to the project which escalation to ESA/NoR provider is needed.

Risk	Risk Severity	Risk Likelihood	Risk Category	Risk Status	Possible mitigation
Schedule slips Increased cost for using the ESA Cloud	Major	Medium	Schedule Functionality Cost	Mo	Depending on what the ESA cloud could deliver in terms of needed services in regards of the overall cloud infrastructure components we need to implement some of the components ourselves which has an impact on both the cost as well as the schedule. Examples are ready to use terraform provider, a managed k8s cluster vs one which needs to be configured ourselves. To minimize the risk, a dedicated work package (WP2) is allocated to setup the initial design based on the available infrastructure. Any major deviations from the initial assumptions will be flagged and discussed with the project TO.
ESA EOIAM: Schedule slips	Medium		Schedule Functionality	Mo	Depending on the support of ESA EOIAM implementation regarding OpenID or SAML the Keycloak integration will be out of the box or custom integration needs to be investigated. The design of the user management system will be part of WP2 that will start at KO. Any major deviations from the initial assumptions will be flagged and discussed with the project TO.
Increased cost Storage	Medium	Medium	Cost	Mo	Since it's unclear how many projects will land on the portal and how many data, they will need the cost of consuming storage at a cloud provider could grow significantly. This could be mitigated by using additional NoR sponsoring
Algorithms change <b>during</b> upscaling or enhancement	Medium	Low	Schedule Functionality Cost	Mo	Often, (scientific) algorithms are continuously updated. This can happen even in parallel to our work to upscale or enhance them. It would mean that there is unplanned, extra work to catch-up with the changes ("working against a moving target"). A simple mitigation would be to complete the work on the algorithm version delivered at the beginning of the work. However, it is a risk then that the APEx version of the algorithm would not be used by the community. Alternatively, schedule needs to be adapted and price increased.

Risk	Risk Severity	Risk Likelihood	Risk Category	Risk Status	Possible mitigation
Algorithms change <b>after</b> upscaling or enhancement	Major	Low	APEX success	Mv	Often, (scientific) algorithms are continued to be updated. Consequently, the versions of the algorithms available on APEX will become outdated after a while and useless. The investment made by ESA on those algorithms would be lost. As a mitigation strategy we recommend including, from the beginning, a strategy to keep the algorithm developers attached to APEX and establish an agreement that they – ideally – use the APEX version for future development work, or, if they do not accept, agree that they keep APEX informed. Part of the strategy is also an activity within APEX to federate their algorithm developers and have funding available to implement algorithm updates in APEX following the scientific developments.
Delay in the delivery of the User Workspace and IDE Services	Medium	Medium	Schedule Functionality	Mo	Issues with the Storage components on the OTC cloud environment can cause a delay in the delivery of the User Workspace and IDE components due to its dependency on this cloud component. Inuits has created a ticket for this, which is closely being monitored. Escalation to the OTC management has already been done.

## 5 MILESTONES & MEETINGS

Table 8. Milestones & meetings

ID	Milestone Name	Location	Description	Date
KO	Kick-off Meeting	ESRIN	Formally kick-off the activity, also inviting representatives of relevant related activities. Initiate the detailed implementation of the services	15/04/2024
PM1	Progress Meeting	Telco	Monthly progress meeting	15/05/2024
PM2	Progress Meeting	Telco	Monthly progress meeting	19/06/2024
PM3	Progress Meeting	Telco	Monthly progress meeting	17/07/2024
PM4	Progress Meeting	Telco	Monthly progress meeting	26/08/2024
PM5	Progress Meeting	Telco	Monthly progress meeting	18/09/2024
PM6	Progress Meeting	Telco	Monthly progress meeting	16/10/2024
SRR	Service Readiness Review	VITO / Hybrid	Demonstration and review of the prototype implementation of the APEx services.	13/11/2024
PM7	Progress Meeting	Telco	Monthly progress meeting	18/12/2024
PM8	Progress Meeting	Telco	Monthly progress meeting	22/01/2025
PM9	Progress Meeting	Telco	Monthly progress meeting	26/02/2025
PM10	Progress Meeting	Telco	Monthly progress meeting	19/03/2025



ID	Milestone Name	Location	Description	Date
PM11	Progress Meeting	Telco	Monthly progress meeting	16/04/2025
MTR	Mid Term Review	ESRIN	Mid Term review of the status of APEx services and support to related activities alignment for activities for second half of activity.	22/05/2025
SOR 1	Service Operations Review	ESRIN	Report and review status of APEx services including facilitated algorithm hosting. Review agreed set of KPI including number active users, number and performance of hosted algorithms, instantiated environments, performance of integrated services, etc.	22/05/2025
PM12	Progress Meeting	Telco	Monthly progress meeting	15/06/2025
PM13	Progress Meeting	Telco	Monthly progress meeting	15/07/2025
PM14	Progress Meeting	Telco	Monthly progress meeting	15/08/2025
PM15	Progress Meeting	Telco	Monthly progress meeting	15/09/2025
SOR 2	Service Operations Review	VITO / Hybrid	Report and review status of APEx services including facilitated algorithm hosting. Review agreed set of KPI including number active users, number and performance of hosted algorithms, instantiated environments, performance of integrated services, etc.	15/10/2025
PM16	Progress Meeting	Telco	Monthly progress meeting	15/11/2025
PM17	Progress Meeting	Telco	Monthly progress meeting	15/12/2025
AUC	APEx User Consultation	TBD	Organise a user consultation event, ideally colocated with another EO community event, to interact in-person with APEx users and algorithm providers to exchange on experiences and gather further recommendations for improvements.	15/12/2025
PM18	Progress Meeting	Telco	Monthly progress meeting	15/01/2026

ID	Milestone Name	Location	Description	Date
SOR 3	Service Operations Review	VITO / Hybrid	Report and review status of APEx services including facilitated algorithm hosting. Review agreed set of KPI including number active users, number and performance of hosted algorithms, instantiated environments, performance of integrated services, etc.	15/02/2026
PM19	Progress Meeting	Telco	Monthly progress meeting	15/03/2026
FR	Final Review	ESRIN	Demonstration and review of the achievements and services developed during the initial 2 years of the activity.	15/04/2026

## 6 DELIVERABLES

The various project deliverables are accessible through a dedicated SharePoint environment and/or GitHub repositories, as outlined in section 3.1.9.

### 6.1 Deliverables Phase In

*Table 9. Documentation delivery plan – Phase In*

Ref.	WP	Deliverable	Milestone name	# Copies
D01-PMP	WP1	Project Management Plan	KO SRR	Digital, PDF, MS-WORD
D02-AIL	WP1	Action Item List	KO PMX (bi-monthly) SRR	Digital, PDF, MS-WORD
D03-MOM	WP1	Minutes of Meeting	KO PMX (bi-monthly)	Digital, PDF, MS-WORD
D04-MPR	WP1	Bi-monthly Progress Report	Bi-monthly	Digital, PDF, MS-WORD
D05-QPR	WP1	Quarterly Progress Report	Quarterly	Digital, PDF, MS-WORD
D06-SPR	WP1	Semestrial Progress Report	Every 6 months	Digital, PDF, MS-WORD
D07-AG	WP1	Meeting Agenda	KO PMX (bi-monthly) SRR	Digital, PDF, MS-WORD
D08-HO	WP1	Meeting Hand-outs	KO PMX (bi-monthly) SRR	Digital, PDF, MS-WORD
D09-ICG	WP2	Interoperability and Compliance Guidelines	KO SRR	Digital, PDF, MS-WORD
D10-TOV	WP2	APEX Services Test Suite and Operational Verification Report	SRR	Digital, PDF, MS-WORD
D11-ISS	WP4	APEX Instantiation Services & Specifications	SRR	Digital, PDF, MS-WORD
D12-PSS	WP5	APEX Propagation Services & Specifications	SRR	Digital, PDF, MS-WORD
D13-COR	WP6	Communication & Outreach Report	SRR	Digital, PDF, MS-WORD

Table 10. Software delivery plan – Phase In

Ref.	WP	Deliverable	Milestone name	Format
S01-PRT	WP3	APEX Portal (v1)	SRR	Webpage
S02-PP	WP4	Project Portal Service (MVP)	SRR	Code repository
S03-DS	WP4	Geospatial Explorer Service (MVP)	SRR	Code repository, NoR service
S04-IDE	WP4	Interactive Development Environments (MVP)	SRR	Code repository
S05-UW	WP4	User Workspace (MVP)	SRR	Code repository
S06-CAT	WP4	Catalogue (MVP)	SRR	Code repository

## 6.2 Deliverables Operational Phase

Table 11. Documentation delivery plan – Operational Phase

Ref.	WP	Deliverable	Milestone name	# Copies
D01-PMP	WP7	Project Management Plan	MTR SORX FR	Digital, PDF, MS-WORD
D02-AIL	WP7	Action Item List	MTR SORX FR	Digital, PDF, MS-WORD
D03-MOM	WP7	Minutes of Meeting	MTR SORX PMX (bi-monthly) FR	Digital, PDF, MS-WORD
D04-MPR	WP7	Bi-monthly Progress Report	Bi-monthly	Digital, PDF, MS-WORD
D05-QPR	WP7	Quarterly Progress Report	Quarterly	Digital, PDF, MS-WORD
D06-SPR	WP7	Semestrial Progress Report	Every 6 months	Digital, PDF, MS-WORD
D07-AG	WP7	Meeting Agenda	MTR SORX PMX (bi-monthly) FR	Digital, PDF, MS-WORD
D08-HO	WP7	Meeting Hand-outs	MTR SORX PMX (bi-monthly) FR	Digital, PDF, MS-WORD
D16-FR	WP7	Final Report	FR	Digital, PDF, MS-WORD

Ref.	WP	Deliverable	Milestone name	# Copies
D15-CCD	WP7	Contractual Closure Documentation	FR	Digital, PDF, MS-WORD
D09-ICG	WP8	Interoperability and Compliance guidelines	MTR SORX FR	Digital, PDF, MS-WORD
D10-TOV	WP8	APEX Services Test Suite and Operational Verification Report	MTR SORX FR	Digital, PDF, MS-WORD
D11-ISS	WP9	APEX Instantiation Services & Specifications	MTR SORX FR	Digital, PDF, MS-WORD
D12-PSS	WP10	APEX Propagation Services & Specifications	MTR SORX FR	Digital, PDF, MS-WORD
D13-COR	WP11	Communication & Outreach Report	MTR SORX FR	Digital, PDF, MS-WORD

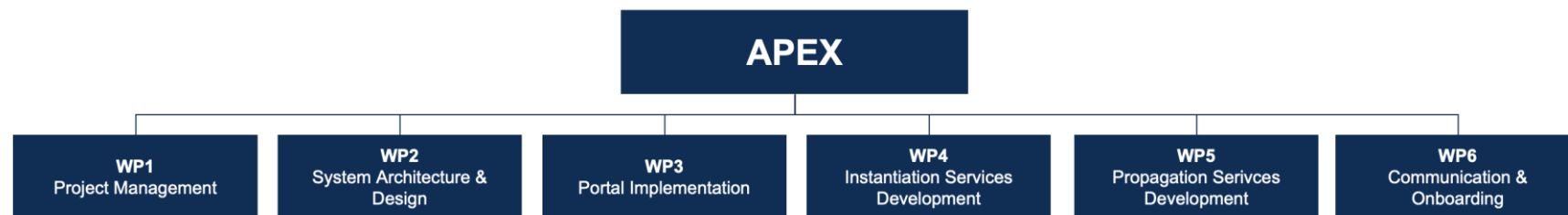
Table 12. Software delivery plan – Operational Phase

Ref.	WP	Deliverable	Milestone name	Format
S01-PRT	WP8	APEX Portal (v2)	FR	Webpage
S02-PP	WP9	Project Portal Service (v1)	FR	Code repository, NoR service
S03-DS	WP9	Geospatial Explorer Service (v1)	FR	Code repository, NoR service
S04-IDE	WP9	Interactive Development Environments (v1)	FR	Code repository, NoR service
S05-UW	WP9	User Workspace (v1)	FR	Code repository, NoR service
S06-CAT	WP9	Catalogue (v1)	FR	Code repository, NoR service
S07-UF	WP9	User Forum Service (v1)	FR	Code repository, NoR service
S08-DOC	WP9	Documentation Service (v1)	FR	Code repository, NoR service
S09-AHS	WP10	Algorithm Hosting Service (v1)	FR	NoR service
S10-AUS	WP10	Algorithm Upscaling Service (v1)	FR	NoR service

Ref.	WP	Deliverable	Milestone name	Format
S11-AES	WP10	Algorithm Enhancement Service (v1)	FR	NoR service
S12-TCS	WP10	Toolbox Cloudification Service (v1)	FR	NoR service
S13-AIS	WP10	Algorithm Intercomparison Service (v1)	FR	NoR service

## 7 WORK BREAKDOWN

The APEx project is implemented into two phases: Phase In and Operational Phase. The Phase In includes important tasks, such as requirement engineering, technical specifications, and the initial platform and service development, while the Operational Phase focuses on provisioning and enhancements of the platform and its services.



*Figure 1. Work Breakdown Structure (WBS) of Phase In*



*Figure 2. Work Breakdown Structure (WBS) of Operational Phase*

## 7.1 Work Package Descriptions

### 7.1.1 Phase In

PROJECT: APEx	PHASE: Phase In	WP: 1
<b>WP Title:</b> Project Management <b>Contractor Lead:</b> VITO <b>Start Event:</b> KO <b>End Event:</b> SRR <b>WP Manager:</b> Bram Janssen <b>Participants:</b> n/a		Sheet 1 of 1 Issue Ref: 1.0 Issue Date
<b>WP Objective</b>  The objective of WP1 is to oversee and coordinate all project activities throughout Phase In. Its primary objectives are to ensure the seamless and consistent execution of the different tasks and to maintain communication with ESA.		
<b>WP Inputs</b> <ul style="list-style-type: none"> <li>• Project proposal</li> <li>• Statement of work</li> <li>• The Project Management Plan (PMP) as agreed at KO.</li> </ul>		
<b>Tasks</b> <ul style="list-style-type: none"> <li>• Monitor progress of each task, identify potential delays, and ensure adequate mitigation measures are put in place.</li> <li>• Provide progress reports to ESA:               <ul style="list-style-type: none"> <li>○ Every 2 Months: Provide brief progress reports, summarizing the progress during the reporting period, highlighting problems resolved and new issues encountered, updating on actions being implemented, and outlining upcoming activities.</li> <li>○ Every quarter: resent a concise, high-level overview of the project's progress during the last quarter.</li> <li>○ Every 6 months: Create 3-5 visually appealing highlight PowerPoint slides to cover significant project activities.</li> </ul> </li> <li>• Ensure timely submission of all deliverables to ESA.</li> <li>• Attend progress meetings and ensure attendance by all necessary project team members.</li> <li>• Providing minutes of all meetings. These shall be circulated to ESA for approval within two working days of the appropriate meeting and be provided in final format within two working days of approval. This shall include:               <ul style="list-style-type: none"> <li>○ Minutes of any negotiation meetings prior to contract kick-off</li> <li>○ Minutes of the KO Meeting</li> <li>○ Minutes of all Progress Meeting</li> <li>○ Minutes of Milestone Meetings</li> </ul> </li> </ul>		



## WP Outputs/Results

Deliverables:

- D01-PMP : Project Management Plan
- D02-AIL : Action Item List
- D03-MOM : Minutes of Meeting
- D04-MPR : Bi-monthly Progress Report
- D05-QPR : Quarterly Progress Report
- D06-SPR : Semestrial Progress Report
- D06-AG : Meeting Agenda
- D07-HO : Meeting Hand-outs

**Total Person Hours: 624**

**PROJECT: APEX**

**PHASE: Phase In**

**WP: 2**

**WP Title:** System Architecture & Design

**Contractor Lead:** VITO

**Start Event:** KO

Planned Date: Apr 2024

**End Event:** SRR

Planned Date: Oct 2024

**WP Manager:** Jeroen Dries

**Participants:** Terradue, Brockmann Consult, Sparkgeo Consulting Inc, Inuits

Sheet 1 of 1

Issue Ref: 1.0

Issue Date

## WP Objective

The objective of WP2 is to define the system design for APEX. This process will consider all system-related requirements, resulting in an initial design that serves as the foundation for the development of all APEX services. As part of the execution of this work package, the base infrastructure for APEX will be established.

## WP Inputs

- D01-PMP : Project Management Plan
- System requirements from:
  - Project Proposal
  - Existing partner solutions
- Interoperability and Compliance Guidelines

## Tasks

*T2.1 System Design (VITO)*

Develop the foundational system design for APEx, establishing guidelines for both the overall platform and the seamless integration of the different APEx services.

- Collect boundary conditions from components provided by: ESA-Cloud, Earth-Code and existing NoR services.
- Identify interoperable building blocks from EOEPKA.
- Create a system design for APEx.
- Define procedures for deploying and operating the APEx services.
- Specify the requirements for algorithm hosting environments to integrate with the APEx services.
- Define the requirements for algorithms to maximize usability and minimize maintenance.
- Outline the process for hosting and algorithm providers to check and prove compliancy with the APEx requirements.
- Define Service Level Agreements (SLA) and Operational Level Agreements (OLA).
- Align design with related activities, including Interoperable Building Blocks, SEF, and other relevant NoR providers.
- Define compliancy requirements for project results and lifecycle management of those results.
- Define product development plan and roadmap.

### *T2.2 Infrastructure Setup (Inuits)*

Setup the base cloud infrastructure to be used by APEx and its associated services.

- Explore the ESA Cloud components.
- Explore the openTofu integration with ESA Cloud.
- Define plan and roadmap based on the design.
- Setup the base container infrastructure to build, deploy and operate the APEx base platform and services.
- Setup the configuration regarding S3 buckets.
- Based on the needs investigate the options of a CSI provider for storage based on S3 to deliver file-based storage within a container which ends up as data in an S3 bucket.
- Define the ingress/egress components.
- Setup the CI/D platform based on Helm charts to deploy workload on the base container infrastructure.
- Build-up documentation about the platform and how to use CI/CD.

### **WP Outputs/Results**

Deliverables:

- D09-ICG: Interoperability and Compliance Guidelines
- D10-TOV: APEx Services Test Suite and Operational Verification Report

**Total Person Hours: 2008**

PROJECT: APEX		PHASE: Phase In	WP: 3
<b>WP Title:</b> Portal Implementation			Sheet 1 of 1
<b>Contractor Lead:</b> VITO			Issue Ref: 1.0
<b>Start Event:</b> KO		Planned Date: Apr 2024	Issue Date
<b>End Event:</b> SRR		Planned Date: Oct 2024	
<b>WP Manager:</b> Bram Janssen			
<b>Participants:</b> Terradue, Brockmann Consult, Sparkgeo Consulting Inc, Inuits			
<p><b>WP Objective</b></p> <p>WP3 will focus on deploying the initial APEX portal, including a basic web portal and deployment of the base components. This effort ensures the full operational readiness of the APEX portal. The tasks within this work package have a direct link with the efforts undertaken in WP2.</p> <p><b>WP Inputs</b></p> <ul style="list-style-type: none"> <li>• D01-PMP : Project Management Plan</li> <li>• D09-ICG: Interoperability and Compliance Guidelines</li> <li>• Branding guidelines</li> <li>• System design</li> </ul> <p><b>Tasks</b></p> <p><i>T3.1 Portal Setup (VITO)</i></p> <p>Create and deploy the first version of the main APEX portal.</p> <ul style="list-style-type: none"> <li>• Design, implement and deploy of the main APEX Portal.</li> <li>• Define product development plan and roadmap.</li> </ul> <p><i>T3.2 User Management (Inuits)</i></p> <p>Implement and integrate user management components to be utilized across APEX and its associated services.</p> <ul style="list-style-type: none"> <li>• Explore the possibilities with ESA EOIAM in regard of Keycloak (OpenID vs SAML).</li> <li>• Define a roadmap based on the design.</li> <li>• Establish a user management system for use across the APEX portal, supporting the integration with ESA EOIAM identity management system.</li> <li>• Integrate the user management system into the web portal.</li> </ul> <p><i>T3.3 Infrastructure Dashboards (Inuits)</i></p> <p>Deliver and configure components to establish operational dashboards within APEX.</p>			

- Deploy a Prometheus / Grafana setup using the CI/CD.
- Implement the Kubernetes Prometheus exporter.
- Develop operations dashboard to monitor the health, availability, and usage of the APEx and its services.
- Integrate an operational dashboard into the web portal.

#### *T3.4 Documentation (VITO)*

Establish the APEx documentation portal, featuring comprehensive information on the platform's capabilities.

- Set up of a basic documentation portal to host APEx-related documentation using the common CI/CD approach.
- Integrate the documentation portal into the web portal.
- Create tutorials to support users and projects.

#### **WP Outputs/Results**

Deliverables:

- S01-PRT – APEx Portal (v1)

**Total Person Hours: 1088**

#### **PROJECT: APEx**

#### **PHASE: Phase In**

#### **WP: 4**

**WP Title:** Instantiation Services Development

**Contractor Lead:** Terradue

**Start Event:** KO

Planned Date: Apr 2024

**End Event:** SRR

Planned Date: Oct 2024

**WP Manager:** Pedro Gonçalves

**Participants:** VITO, Sparkgeo Consulting Inc, Inuits

Sheet 1 of 1

Issue Ref: 1.0

Issue Date

#### **WP Objective**

The goal of WP4 is to create an initial version of all instantiation services offered by APEx. For the Phase In, the focus of these services is on developing a minimal viable product. The integration of the new instantiation services within APEx will be carried out in synergy with the efforts done in WP2. Close cooperation with WP6 ensures that the progress within WP4 is tracked and communicated within the APEx user community.

#### **WP Inputs**

- D01-PMP : Project Management Plan
- D09-ICG: Interoperability and Compliance Guidelines
- Statement of work
- System design

## Tasks

### *T4.1 Project Portal Service (VITO)*

Develop an MVP service for dynamically instantiating project portals.

- Develop a service for dynamically providing a basic project portal with customizable branding.
- Define procedures for instantiating and operating the project portal service.
- Define relevant Key Performance Indicators (KPIs) for monitoring the performance and availability of the project portals.
- Define product development plan and operationalisation roadmap.

### *T4.2 Geospatial Explorer Service (Sparkgeo Consulting Inc)*

Develop an operational service for instantiating dashboards and support the existing dashboard initiatives in their transition to APEX.

- Create a robust dashboard solution for communicating EO data and projects through APEX based on OpenLayers.
- Enhance support from OpenLayers Features for various data formats, protocols, and a strong open-source legacy.
- Integrate with EO Data used in EODash applications; compatible with WMS and WMTS protocols, facilitating flexible layer integration.
- Support OGC Features API and WFS protocols.
- Provide layer ordering, transparency adjustments, and blending.
- Enable advanced functionalities capable of inferring cursor location values, measuring distances.
- Allow tabular data visualization allowing the joining of tabular data to geospatial boundary layers for spatial filtering, enabling access to tabular data within geospatial boundaries in dashboards following specific geospatial rules.
- Add support within the Geospatial Explorer for accessing data defined as STAC assets.
- Setup instantiation mechanism to deploy the Geospatial Explorer UI & config, and relevant backend services.
- Define procedures for instantiating and operating the Geospatial Explorer service.
- Define a Service Level Agreement (SLA) and an Operational Level Agreement (OLA) for service.
- Define relevant Key Performance Indicators (KPIs) for monitoring the performance and availability of the Geospatial Explorer instantiations.
- Report and integrate KPI metrics into an operational dashboard.
- Define product development plan and operationalisation roadmap.

#### *T4.3 Interactive Development Environments (Terradue)*

Develop a detailed guide for setting up and operating the Integrated Development Environment (IDE) on the Visual Studio Code Server.

- Include step-by-step instructions for initializing the server-based IDE, tailored for varying levels of technical expertise.
- Emphasize the use of containerization technologies in the IDE for consistent application behaviour across different environments.
- Detail the process for encapsulating applications with necessary configurations and dependencies for easy deployment.
- Integrate the Common Workflow Language (CWL) to standardize application workflows, enhancing collaboration and ensuring smooth operation across various execution contexts.
- Implement the support of the openEO client libraries.
- Implement seamless integration with GitLab for efficient code repository management, version control, and collaborative development.
- Incorporate CI tools to automate build, test, and deployment tasks, ensuring applications are always ready for deployment.
- Establish clear protocols for transitioning applications from development to production, including options for repository hosting or configuration as an OGC API — Processes compliant web service.
- Utilize a cloud-native architecture through orchestrated containerization with Kubernetes, ensuring scalability, resilience, and efficient load distribution.
- Support the binding of Docker containers to encapsulate the computational environment of workflow steps.
- Establish KPIs to monitor IDE performance, focusing on server responsiveness, uptime, and efficiency in handling resource-intensive tasks.
- Implement KPIs for tracking user engagement and satisfaction with the IDE, particularly in terms of ease of use and accessibility from different locations and devices.
- Develop a roadmap for the IDE's operational rollout, including milestones for key stages such as initial deployment, user training, and full integration into the development workflow.
- Include strategies for continuous improvement and updates based on user feedback and evolving technology standards.

#### *T4.4 User Workspace (Terradue)*

Develop comprehensive procedures for setting up and managing the APEX User Workspace, ensuring a straightforward process for users to instantiate and operate their personalized workspace.

- Include guidelines on customizing the workspace environment, such as adjusting the look and feel to align with specific project requirements.
- Ensure the architectural design of the User Workspace emphasizes scalability, allowing it to adapt to the changing needs and scales of various EO projects.

- Plan for the expansion of storage capabilities and the integration of new tools and functionalities to cater to evolving user requirements.
- Outline a clear product development plan for the User Workspace that details the phases of development, from initial concept to full deployment.
- The plan should encompass the integration of key features like secure data storage, user-friendly data sharing mechanisms, and seamless integration with EO datasets and APEX Instantiation Services.
- Establish KPIs to evaluate the performance and availability of the User Workspace. These should include metrics such as system uptime, response time, and data access speed.
- Monitor user engagement and satisfaction levels, particularly focusing on the ease of data sharing, interaction within the community forum, and overall user experience.
- Develop an operationalisation roadmap that charts the progression of the User Workspace from a development phase to an operational state.
- Include timelines for key milestones such as the initial rollout, integration with ESA's Network of Resources, user training, and feedback incorporation.
- Incorporate features that promote community engagement, such as a forum for user interaction and knowledge exchange.
- Develop mechanisms for secure and efficient data sharing among users, fostering collaboration without compromising data integrity.
- Ensure that the User Workspace is coherently integrated with other components of the APEX Instantiation Services, providing users with a unified experience across APEX.
- Facilitate direct interfacing with EO datasets and applications within the User Workspace to streamline user workflows.

#### *T4.5 Catalogue (VITO)*

Create a service for instantiating a catalogue service and define/integrate operational procedures for data ingestion.

- Develop a service to dynamically create a STAC based catalogue.
- Define clear and detailed procedures for ingesting data into the catalogue. This includes steps for data validation, metadata extraction, and indexing.
- Establish guidelines for batch and real-time data ingestion processes, ensuring they are optimized for different types of EO data and sources. Integrate catalogue service with user management, allowing projects to manage their own public & private collections.
- Integrate existing services (openEO/EOEPCA) to support data ingestion into an APEX instantiated catalogue.
- Define the procedures for instantiating and operating the catalogue service.
- Define relevant Key Performance Indicators (KPIs) for monitoring the performance and availability of the catalogue and data ingestion processes.
- Define product development plan and operationalisation roadmap.

#### **WP Outputs/Results**

Deliverables:

- D11-ISS: APEX Instantiation Services & Specifications
- S02-PP: Project Portal Service (MVP)



- S03-DS: Geospatial Explorer Service (MVP)
- S04-IDE: Interactive Development Environments (MVP)
- S05-UW: User Workspace (MVP)
- S06-CAT: Catalogue (MVP)

**Total Person Hours: 2602**

PROJECT: APEX		PHASE: Phase In	WP: 5
<b>WP Title:</b> Propagation Services Development			Sheet 1 of 1
<b>Contractor Lead:</b> VITO			Issue Ref: 1.0
<b>Start Event:</b> KO		Planned Date: Apr 2024	Issue Date
<b>End Event:</b> SRR		Planned Date: Oct 2024	
<b>WP Manager:</b> Jeroen Dries			
<b>Participants:</b> Terradue, Brockmann Consult, Inuits			
<p><b>WP Objective</b></p> <p>WP5 focusses on the initial offering of the APEX propagation services. This includes the development of new services and the definition of procedures for executing and operating these propagation services. The integration of the new propagation services within APEX will be carried out in synergy with the efforts done in WP2. Close cooperation with WP6 ensures that the progress within WP5 is tracked and communicated within the APEX user community.</p> <p><b>WP Inputs</b></p> <ul style="list-style-type: none"> <li>• D01-PMP : Project Management Plan</li> <li>• D09-ICG: Interoperability and Compliance Guidelines</li> <li>• Statement of work</li> <li>• System design</li> </ul> <p><b>Tasks</b></p> <p><i>T5.1 Algorithm Hosting Service (Terradue)</i></p> <p>Develop and deploy intuitive user interfaces for the Algorithm Hosting Service. These interfaces should be designed to facilitate easy access and management of algorithms by users.</p> <ul style="list-style-type: none"> <li>• Ensure that the interfaces are user-friendly and provide clear guidance on how to host and access algorithms within the APEX environment.</li> <li>• Define and document comprehensive management procedures for the Algorithm Hosting Service. These procedures should cover aspects such as algorithm submission, review, approval, and updating.</li> </ul>			



- Include guidelines for maintaining the quality and relevance of hosted algorithms, ensuring they meet the compliance requirements and standards set by APEx.
- Identify and implement relevant KPIs to monitor the usage, performance, and availability of the Algorithm Hosting Service. KPIs should include metrics like the number of algorithms hosted, user engagement levels, service uptime, and response times.
- Enable support for workflows that combine 'Application Package' (encoded in CWL) with openEO process graphs. This integration is crucial for enhancing the service's capability to handle complex EO processing tasks.
- Ensure that the service can seamlessly integrate these workflows, providing a robust platform for diverse EO applications.
- Facilitate the integration of openEO User-Defined Processes (UDP) and Application Package (CWL) based services into the NoR as standalone services.
- Implement features for accounting metrics such as cost per square kilometre, providing users with clear insights into the usage costs of their algorithms.
- Develop a detailed product development plan for the Algorithm Hosting Service. This plan should outline key phases, milestones, and timelines for the service's development and deployment.
- Create an operationalisation roadmap that charts the path from service development to full-scale operational deployment, including strategies for user training, feedback incorporation, and continuous service improvement.

#### *T5.2 Algorithm Upscaling Service (Terradue)*

Develop and implement the Algorithm Upscaling Service.

- Focus on creating a service that enables users to scale their algorithms and workflows over larger geographical or temporal extents of EO data efficiently.
- Design the service to abstract data management complexities such as tiling/chunking, parallelization, handling diverse file paths and formats, CRS, and projections.
- Ensure the service simplifies these aspects to facilitate user-friendly application of algorithms to large-scale EO processing operations, like continental-global or full archive time periods.
- Incorporate a dedicated mechanism within the service that allows users to upscale workflows or algorithms geographically or temporally based on their needs.
- Communicate the costs associated with upscaling processing to users within the algorithm hosting environment, with the provision that these costs are covered by the NoR for pre-commercial use.
- Ensure that these estimations and profiles are accurate and helpful for users in making informed decisions regarding their processing operations.
- Make the service accessible and compatible with a variety of user-defined algorithms and workflows, supporting a range of coding languages and software libraries.
- Ensure seamless integration of the Algorithm Upscaling Service with other components of APEx, particularly focusing on interoperability with the Application Package and data catalogues.
- Implement monitoring tools to track the performance and effectiveness of the upscaling service.
- Continuously optimize the service based on user feedback and evolving requirements in the field of EO.

### *T5.3 Algorithm Enhancement Service (Brockmann Consult)*

Define operational procedures and implement the Algorithm Enhancement Service.

- Refine two-phase approach, define scope of analysis phase, and expected variety of algorithms to be enhanced.
- Define a default procedure and respective checklist and report template for the analysis phase.
- Define conditions to be imposed to algorithms provided to make use of the standardized analysis.
- Estimate the effort for the analysis phase in a “normal” case.
- Define how to make use of the algorithm hosting service to integrate enhanced algorithms into the APEX offer.
- Define relevant Key Performance Indicators (KPIs) for monitoring the performance and availability of the algorithm enhancement services.
- Define product development plan and operationalisation roadmap.

### *T5.4 Toolbox Cloudification Service (Brockmann Consult)*

Define operational procedures and implement a Toolbox Cloudification Service.

- Review understanding of toolbox cloudification scope with ESA.
- Develop use cases, review the key functional blocks provided in the proposal.
- Develop architecture design for cloudified toolboxes.
- Implement minimal viable service.
- Define relevant Key Performance Indicators (KPIs) for monitoring the usage, performance, and availability of the toolbox cloudification.
- Define product development plan and operationalisation roadmap.

### *T5.5 Algorithm Intercomparison Service (Brockmann Consult)*

Develop and implement the Algorithm Intercomparison Service.

- Analyse the various types of algorithm intercomparison procedures.
- Develop a generalised model for an algorithm intercomparison service.
- Specify the APEX components to be used and configured.
- Specify the intercomparison methods, metrics, plots, and reports to be generated.
- Set-up a minimum viable service.
- Define relevant Key Performance Indicators (KPIs) for monitoring the usage, performance, and availability of the toolbox cloudification.
- Define product development plan and operationalisation roadmap.

## **WP Outputs/Results**

Deliverables:

- D12-PSS: APEX Propagation Services & Specifications

**Total Person Hours: 1623**

PROJECT: APEX		PHASE: Phase In	WP: 6
<b>WP Title:</b> Communication & Onboarding			Sheet 1 of 1
<b>Contractor Lead:</b> VITO			Issue Ref: 1.0
<b>Start Event:</b> KO	Planned Date: Apr 2024		Issue Date
<b>End Event:</b> SRR	Planned Date: Oct 2024		
<b>WP Manager:</b> Evelyn Stynen			
<b>Participants:</b> Terradue, Brockmann Consult			
<p><b>WP Objective</b></p> <p>WP6 aims to manage the communication with the APEX user community, facilitate engagement within the broader Earth Observation (EO) community, onboard the SEF initiatives and application projects, integrate APEX-based services onto the NoR, and ensure the ongoing enhancement of APEX services through user feedback.</p> <p><b>WP Inputs</b></p> <ul style="list-style-type: none"> <li>• D01-PMP : Project Management Plan</li> </ul> <p><b>Tasks</b></p> <p><i>T6.1. Business Plan Development (VITO)</i></p> <ul style="list-style-type: none"> <li>• Define the cost models to be applied for all the APEX services.</li> </ul> <p><i>T6.2 NoR Onboarding (VITO)</i></p> <ul style="list-style-type: none"> <li>• Onboard Geospatial Explorer Service on ESA's Network of Resources. This includes technical integration, testing, and deployment strategies.</li> <li>• Establish a system for monitoring incoming requests from NoR and responding promptly. This system should be designed to handle queries, feedback, and support requests effectively.</li> <li>• Create detailed documentation and training materials to assist users in navigating and utilizing the Geospatial Explorer Service within the NoR.</li> </ul> <p><i>T6.3 Project Onboarding (VITO)</i></p> <ul style="list-style-type: none"> <li>• Establish onboarding criteria. These criteria should encompass technical compatibility, strategic alignment, and potential impact.</li> <li>• Define list of project candidates to onboard. This list should be regularly reviewed and updated.</li> </ul>			

- Manage relationships with external projects.
- Create communication plan for onboarding projects.
- Support the onboarding of projects on APEX. This includes offering technical assistance, guidance on integration with APEX services, and resolving any challenges that arise during the onboarding process.

#### *T6.4 Communication (VITO)*

- Identify relevant stakeholders and target user grounds.
- Define a communication plan.
- Create communication materials, including social media profiles.
- Execute the communication plan based on the project's progress.
- Writing of technical blog posts.
- Writing of use-case focused blog posts.
- Collect feedback from users.

#### **WP Outputs/Results**

Deliverables:

- D11-ISS: APEX Instantiation Services & Specifications
- D12-PSS: APEX Propagation Services & Specifications
- D13-COR: Communication & Outreach Report

**Total Person Hours: 508**

### **7.1.2 Operational Phase**

<b>PROJECT: APEX</b>		<b>PHASE: Operational Phase</b>	<b>WP: 7</b>
<b>WP Title:</b> Project Management			Sheet 1 of 1
<b>Contractor Lead:</b> VITO			Issue Ref: 1.0
<b>Start Event:</b> SRR		Planned Date: Oct 2024	Issue Date
<b>End Event:</b> FR		Planned Date: Apr 2026	
<b>WP Manager:</b> Bram Janssen			
<b>Participants:</b> n/a			
<b>WP Objective</b>			
The objective of WP7 is to oversee and coordinate all project activities throughout Operational Phase. Its primary objectives are to ensure the seamless and consistent execution of the different tasks and to maintain communication with ESA.			
<b>WP Inputs</b>			
<ul style="list-style-type: none"> <li>• Project Proposal</li> <li>• The updated Project Management Plan (PMP) as accepted during SRR.</li> </ul>			

## Tasks

- Monitor progress of each task, identify potential delays, and ensure adequate mitigation measures are put in place.
- Provide progress reports to ESA:
  - Every 2 Months: Provide brief progress reports, summarizing the progress during the reporting period, highlighting problems resolved and new issues encountered, updating on actions being implemented, and outlining upcoming activities.
  - Every quarter: resent a concise, high-level overview of the project's progress during the last quarter.
  - Every 6 months: Create 3-5 visually appealing highlight PowerPoint slides to cover significant project activities.
- Ensure timely submission of all deliverables to ESA.
- Attend progress meetings and ensure attendance by all necessary project team members.
- Providing minutes of all meetings. These shall be circulated to ESA for approval within two working days of the appropriate meeting and be provided in final format within two working days of approval. This shall include:
  - Minutes of any negotiation meetings prior to contract kick-off
  - Minutes of the KO Meeting
  - Minutes of all Progress Meeting
  - Minutes of Milestone Meetings

## WP Outputs/Results

### Deliverables:

- D01-PMP : Project Management Plan
- D02-AIL : Action Item List
- D03-MOM : Minutes of Meeting
- D04-MPR : Bi-monthly Progress Report
- D05-QPR : Quarterly Progress Report
- D06-SPR : Semestrial Progress Report
- D06-AG : Meeting Agenda
- D07-HO : Meeting Hand-outs

**Total Person Hours: 1123**

**PROJECT: APEX**

**PHASE: Operational Phase**

**WP: 8**

**WP Title:** Platform Enhancements

**Contractor Lead:** VITO

**Start Event:** SRR

Planned Date: Oct 2024

**End Event:** FR

Planned Date: Apr 2026

**WP Manager:** Jeroen Dries

**Participants:** Terradue, Brockmann Consult, Sparkgeo Consulting Inc, Inuits

Sheet 1 of 1

Issue Ref: 1.0

Issue Date

**WP Objective**

The goal of WP8 is to advance and operate the base components of APEX. This includes the main APEX portal, the (operational) dashboards, and the underlying infrastructure components. Efforts within this work package will enhance the capabilities and improve operationalization of the platform's instantiation (WP9) and propagation services (WP10).

**WP Inputs**

- D01-PMP : Project Management Plan
- D09-ICG: Interoperability and Compliance Guidelines
- D10-TOV: APEX Services Test Suite and Operational Verification Report
- D11-ISS: APEX Instantiation Services & Specifications
- D12-PSS: APEX Propagation Services & Specifications
- D13-COR: Communication & Outreach Report

**Tasks***T8.1 APEX Portal (VITO)*

Continuing the work of WP3, add new features to the APEX Portal and integrate the new services.

- Enhance the features of the APEX portal based on user feedback.
- Extend the integration of the different APEX services into the main APEX portal.
- Update road map.

*T8.2 Dashboards (Inuits)*

Improve the existing dashboards developed in Task 3.3 and establish new dashboards as required.

- Update the service for providing operational dashboards.
- Work together with the different stakeholders to adjust or create new dashboards based on the redefined needs.

*T8.3 Infrastructure (Inuits)*

Enhance the infrastructure monitoring capabilities and refine operational procedures as outlined in Task 2.2.

- Monitor the health of the base platform.
- Plan updates accordingly on all the different components both within the Kubernetes cluster as well as the components needed to perform the CI/CD, monitoring.

*T8.4 Operations (Inuits)*

Operate the APEX base platform and its services.

- Operate the current APEX service instances.
- Define the operational procedures for the APEX services.

#### *T8.5 Documentation (VITO)*

Extend and enhance the APEX documentation that was created in T3.4

- Extend documentation for new APEX services.
- Enhance documentation based on user feedback.
- Create tutorials to support users and projects.

### **WP Outputs/Results**

Deliverables:

- D09-ICG: Interoperability and Compliance Guidelines
- D10-TOV: APEX Services Test Suite and Operational Verification Report
- S01-PRT: APEX Portal (v2)

**Total Person Hours: 2023**

<b>PROJECT: APEX</b>		<b>PHASE: Operational Phase</b>	<b>WP: 9</b>
<b>WP Title:</b> Instantiation Services Enhancements			Sheet 1 of 1
<b>Contractor Lead:</b> Terradue			Issue Ref: 1.0
<b>Start Event:</b> SRR		Planned Date: Oct 2024	Issue Date
<b>End Event:</b> FR		Planned Date: Apr 2026	
<b>WP Manager:</b> Pedro Gonçalves			
<b>Participants:</b> Terradue, Sparkgeo Consulting Inc, Inuits			
<b>WP Objective</b>			
<p>The objective of WP9 is to improve the initial instantiation services provided by APEX. This involves expanding the offering to include a user forum and documentation portal. Additionally, operational agreements for all instantiation services are defined, and the metrics established during Phase In are captured and reported to operational dashboards within APEX. Close cooperation with WP11 ensures that the progress within WP9 is tracked and communicated within the APEX user community.</p>			
<b>WP Inputs</b>			
<ul style="list-style-type: none"> <li>• D01-PMP : Project Management Plan</li> <li>• D09-ICG: Interoperability and Compliance Guidelines</li> <li>• D10-TOV: APEX Services Test Suite and Operational Verification Report</li> </ul>			



- D11-ISS: APEx Instantiation Services & Specifications
- D13-COR: Communication & Outreach Report

## Tasks

### *T9.1 Project Portal Service (VITO)*

Building upon the initiatives in Task 4.1, enrich the features and capabilities of the project portal service, bringing it to operational readiness.

- Enhance the existing features of the project portal service with a focus on automation and increasing user experience.
- Define a Service Level Agreement (SLA) and an Operational Level Agreement (OLA) for service.
- Report and integrate KPI metrics into an operational dashboard.
- Create relevant tutorials.
- Enhance the project portal features based on product development plan and roadmap.
- Update product development plan and operationalisation roadmap.

### *T9.2 Geospatial Explorer Service (Sparkgeo Consulting Inc)*

Extend and enhance the capabilities of the Geospatial Explorer Service.

- Utilize HTTP JSON and STAC metadata to enforce visualization restrictions based on well-described metadata. Align dashboards with FAIR data principles (Findable, Accessible, Interoperable, Reusable).
- Develop an enhanced user interface for user interactions, tooling, data access, simple data ingest, and linking to a STAC metadata catalogue.
- Deploy OpenLayers for effective communication of Earth Observation (EO) data and derived products to provide the following capabilities:
  - Efficient integration of EO data through WMS and WMTS protocol support.
  - Handling vector data via OGC Features API and WFS protocols, essential for overlaying project results with adjustable settings.
  - Analytical features including layer ordering, transparency control, and advanced blending techniques.
- Enhancing tabular data visualization through OpenLayers within geospatial boundaries by linking tabular data with to the layers, enabling basic spatial filtering.
- Deploy the service as a standalone dashboard with its API backend supporting cloud object storage formats like COG and GeoParquet.
- Support the integration of the visualization in other relevant APEx services.
- Roll out upgrades to instantiated Geospatial Explorers alongside the configuration store.
- Create relevant tutorials.
- Enhance the Geospatial Explorer features based on product development plan and roadmap.
- Update product development plan and operationalisation roadmap.



### *T9.3 Interactive Development Environments (Terradue)*

Build upon the foundation set in T4.3, which included a detailed guide for setting up and operating the IDE, emphasizing containerization technologies, and integrating CI tools and GitLab for collaborative development.

- Enhance the cloud-native architecture and support for Docker containers, while maintaining strong KPI monitoring and user satisfaction metrics.
- Update and expand the guide for setting up and operating the IDE on the Visual Studio Code Server, incorporating advanced tips and best practices.
- Tailor the instructions to cater to a broader range of technical expertise, including advanced scenarios and troubleshooting.
- Implement enhancements to the IDE features as outlined in the product development plan and operational roadmap. This includes refining the user interface, improving functionality, and integrating additional tools or services as needed.
- Define a comprehensive Service Level Agreement (SLA) that outlines the performance expectations, service availability, and support parameters for the IDE.
- Develop an Operational Level Agreement (OLA) that details the operational responsibilities and service management processes to support the SLA.
- Continuously monitor and report on Key Performance Indicators (KPIs) related to the IDE's performance, such as server responsiveness, uptime, and user engagement.
- Develop and update a series of tutorials and guides to assist users in effectively utilizing the IDE. This should include step-by-step instructions covering a range of topics from basic setup to advanced features.
- Ensure these tutorials are accessible and understandable for users with varying levels of technical expertise.
- Continuously update the product development plan and operationalisation roadmap to reflect progress, user feedback, and changes in technology or user requirements.

### *T9.4 User Workspace (Terradue)*

Build upon the initial version which included comprehensive procedures for setting up and managing the User Workspace, emphasizing scalability, and integrating with APEX services and EO datasets.

- Enhance features like secure data storage, user-friendly data sharing, community forum integration, and direct interfacing with EO datasets.
- Maintain strong KPI monitoring and focus on user satisfaction, while expanding storage capabilities and integrating new tools as per evolving requirements.
- Implement enhancements to the User Workspace as outlined in the product development plan and operational roadmap. This includes refining the user interface, improving data management, and sharing features, and integrating additional tools or functionalities.
- Regularly update the workspace features to align with evolving user needs and technological advancements.
- Define a comprehensive Service Level Agreement (SLA) outlining performance expectations, availability, and support parameters for the User Workspace.
- Develop an Operational Level Agreement (OLA) detailing the operational responsibilities and service management processes to support the SLA.

- Continuously monitor and report on Key Performance Indicators (KPIs) related to the User Workspace's performance, such as system uptime, response time, data access speed, and user engagement.
- Integrate these KPI metrics into an operational dashboard for real-time monitoring and decision-making.
- Develop and update a series of tutorials and guides to assist users in effectively utilizing the User Workspace. Include instructions covering basic operations, customization, and advanced features.
- Ensure these tutorials cater to users with different levels of technical expertise and are easily accessible.
- Continuously update the product development plan and operationalisation roadmap for the User Workspace, reflecting user feedback, technological changes, and strategic developments.
- Incorporate strategies for ongoing improvements and future updates, ensuring the workspace remains a cutting-edge tool for the EO community.

#### *T9.5 Catalogue (VITO)*

Build upon the foundation set in T4.5, which included the development of a dynamic STAC-based catalogue service and detailed data ingestion procedures.

- Enhance features like user management integration, real-time data ingestion processes, and integration with existing services like openEO and EOEPKA.
- Maintain robust KPI monitoring, focusing on service performance and data ingestion efficiency, while expanding and refining the catalogue capabilities as per user needs.
- Implement enhancements to the Catalogue features as outlined in the product development plan and operational roadmap. Focus on improving data ingestion processes, user interface, and integration capabilities with other services.
- Regularly update and refine features to ensure they meet the evolving needs of users and align with the latest technological advancements in EO data management.
- Define a comprehensive Service Level Agreement (SLA) that sets out the performance expectations, availability, and support parameters for the Catalogue service.
- Develop an Operational Level Agreement (OLA) detailing the operational responsibilities and service management processes to support the SLA.
- Identify and implement KPIs for monitoring the usage, performance, and availability of the Catalogue service, including data ingestion processes.
- Integrate these KPI metrics into an operational dashboard for continuous monitoring and effective decision-making.
- Develop and update a series of tutorials and guides to assist users in effectively utilizing the Catalogue service. Include instructions covering basic operations, data ingestion, and advanced functionalities.
- Ensure these tutorials are accessible and comprehensible for users with varying levels of technical expertise.
- Continuously update the product development plan and operationalisation roadmap for the Catalogue, reflecting progress, user feedback, and changes in technology or user requirements.
- Incorporate strategies for ongoing improvements and future updates to the Catalogue service, ensuring it remains an effective tool for EO data management.

### T9.6 User Forum (Inuits)

Development of the User Forum service and its seamlessly integration into APEX.

- Development of a service to dynamically create a user forum.
- Define a Service Level Agreement (SLA) and an Operational Level Agreement (OLA) for service.
- Report and integrate KPI metrics into an operational dashboard.
- Create relevant tutorials.
- Create product development plan and operationalisation roadmap.
- Enhance service based on product development plan.

### T9.7 Documentation (Inuits)

Development of the Documentation service as a separate instantiation service based on the concepts used by the main APEX documentation portal.

- Development of a service to dynamically create a documentation portal.
- Define a Service Level Agreement (SLA) and an Operational Level Agreement (OLA) for service.
- Report and integrate KPI metrics into an operational dashboard.
- Create relevant tutorials.
- Create product development plan and operationalisation roadmap.
- Enhance service based on product development plan.

## WP Outputs/Results

Deliverables:

- D11-ISS: APEX Instantiation Services & Specifications
- S02-PP: Project Portal Service (v1)
- S03-DS: Geospatial Explorer Service (v1)
- S04-IDE: Interactive Development Environments (v1)
- S05-UW: User Workspace (v1)
- S06-CAT: Catalogue (v1)
- S07-UF: User Forum Service (v1)
- S08-DOC: Documentation Service (v1)

**Total Person Hours: 3945**

**PROJECT: APEX**

**PHASE: Operational Phase**

**WP: 10**

**WP Title:** Propagation Services Enhancements

Sheet 1 of 1

**Contractor Lead:** VITO

Issue Ref: 1.0

**Start Event:** SRR

Planned Date: Oct 2024

Issue Date

**End Event:** FR

Planned Date: Apr 2026

**WP Manager:** Jeroen Dries**Participants:** Terradue, Brockmann Consult, Inuits**WP Objective**

The objective of WP10 is to improve and operate the initial propagation services provided by APEX. Additionally, operational agreements for all propagation services are defined, and the metrics established during Phase In are captured and reported to operational dashboards within APEX. Close cooperation with WP11 ensures that the progress within WP10 is tracked and communicated within the APEX user community.

**WP Inputs**

- D01-PMP : Project Management Plan
- D09-ICG: Interoperability and Compliance Guidelines
- D10-TOV: APEX Services Test Suite and Operational Verification Report
- D12-PSS: APEX Propagation Services & Specifications
- D13-COR: Communication & Outreach Report

**Tasks***T10.1 Algorithm Hosting Service (Terradue)*

Build upon the foundation set in T5.1, which included the development of user-friendly interfaces and comprehensive management procedures for the Algorithm Hosting Service.

- Enhance support for workflows combining 'Application Package' (CWL) with openEO process graphs and integrate these workflows seamlessly into the service.
- Maintain and improve KPI monitoring, focusing on metrics like algorithm usage, user engagement, service uptime, and response times.
- Continue the integration of openEO UDP and CWL-based services into the NoR as standalone services.
- Upgrade the user interfaces of the Algorithm Hosting Service to enhance user experience, functionality, and accessibility. This includes adding new features, improving navigation, and ensuring compatibility with various devices.
- Focus on making the interfaces more intuitive and efficient for users to host, access, and manage their algorithms within the APEX environment.
- Define and implement a comprehensive Service Level Agreement (SLA) that outlines performance expectations, availability, and support parameters for the Algorithm Hosting Service.
- Develop an Operational Level Agreement (OLA) detailing the operational responsibilities and processes required to support the SLA.
- Refine and integrate KPIs for monitoring the usage, performance, and availability of the Algorithm Hosting Service.
- Ensure these KPIs are accurately represented in an operational dashboard for real-time tracking and effective decision-making.

- Continuously update the product development plan for the Algorithm Hosting Service, reflecting progress, technological advancements, and user feedback.
- Revise and enhance the operationalisation roadmap to chart the ongoing development and deployment of the service, including strategies for user training, feedback incorporation, and continuous improvement.

#### *T10.2 Algorithm Upscaling Service (Terradue)*

Build upon the foundation set in T5.2, which included developing a service for efficiently scaling algorithms and workflows over larger geographical or temporal extents of EO data.

- Continue to simplify data management complexities such as tiling/chunking and parallelization to facilitate the user-friendly application of algorithms to large-scale EO processing operations.
- Maintain the dedicated mechanism within the service for geographic or temporal upscaling of workflows or algorithms according to user needs, ensuring transparent communication of associated costs.
- Enhance the service's accessibility and compatibility with various user-defined algorithms and workflows, supporting a range of coding languages and software libraries.
- Strengthen the integration of the Algorithm Upscaling Service with other APEX components, focusing on interoperability with the Application Package and data catalogues.
- Optimize the service based on ongoing user feedback and the evolving needs in the field of EO.
- Develop a comprehensive Service Level Agreement (SLA) that outlines performance expectations, availability, and support parameters for the Algorithm Upscaling Service.
- Create an Operational Level Agreement (OLA) detailing the operational responsibilities and processes required to support the SLA.
- Refine KPIs for monitoring the usage, performance, and availability of the Algorithm Upscaling Service.
- Integrate these KPIs into an operational dashboard for continuous monitoring and effective management of the service.
- Continuously update the product development plan for the Algorithm Upscaling Service, reflecting technological advancements, user feedback, and strategic developments.
- Revise and enhance the operationalisation roadmap to chart the ongoing development and deployment of the service, including strategies for user training, feedback incorporation, and continuous improvement.

#### *T10.3 Algorithm Enhancement Service (Brockmann Consult)*

Continuing the progress from Task 5.3, refine and enhance the capabilities of the Algorithm Enhancement Service and execute necessary improvements.

- Select most suited partner(s) for candidate algorithms; partners to perform analysis and enhancement.
- Refine procedures for analysis, enhancement, and integration/hosting.

- Extend set of tools for analysis.
- Adapt conditions for algorithms to new capabilities.
- Adapt effort estimation to experience with cases handled.
- Define a Service Level Agreement (SLA) and an Operational Level Agreement (OLA) for service.
- Report and integrate KPI metrics into an operational dashboard.
- Update product development plan and operationalisation roadmap.

#### *T10.4 Toolbox Cloudification Service (Brockmann Consult)*

Continuing the progress from Task 5.4, refine and enhance the capabilities of the Toolbox Cloudification Service and execute the cloudification of candidate toolboxes.

- Further develop the core libraries/API and documentation.
- Perform analysis and assessment of candidate toolboxes, provide cost offer to ESA.
- Select most suited partner(s) for candidate toolbox cloudification; partners to implement identified functionality.
- Integrate new modules into APEx libraries and API.
- Define a Service Level Agreement (SLA) and an Operational Level Agreement (OLA) for service.
- Report and integrate KPI metrics into an operational dashboard.
- Update product development plan and operationalisation roadmap.

#### *T10.5 Algorithm Intercomparison Service (Brockmann Consult)*

Building on the advancements made in Task 5.5, refine, and enhance the capabilities of the Algorithm Intercomparison Service, and provide comparison services.

- Fully implement the components of the algorithm intercomparison service: portal, workspace, IDE, forum etc.
- Develop template protocols.
- Implement demonstration cases to promote the service.
- Provide user support.
- Regularly update the service components based on experience.
- Define a Service Level Agreement (SLA) and an Operational Level Agreement (OLA) for service.
- Report and integrate KPI metrics into an operational dashboard.
- Update product development plan and operationalisation roadmap.

### **WP Outputs/Results**

Deliverables:

- D12-PSS: APEx Propagation Services & Specifications
- S09-AHS: Algorithm Hosting Service (v1)
- S10-AUS: Algorithm Upscaling Service (v1)
- S11-AES: Algorithm Enhancement Service (v1)



- S12-TCS: Toolbox Cloudification Service (v1)
- S13-AIS: Algorithm Intercomparison Service (v1)

**Total Person Hours: 4884**

PROJECT: APEX		PHASE: Operational Phase	WP: 11
<b>WP Title:</b> Communication & Onboarding			Sheet 1 of 1
<b>Contractor Lead:</b> VITO			Issue Ref: 1.0
<b>Start Event:</b> SRR		Planned Date: Oct 2024	Issue Date
<b>End Event:</b> FR		Planned Date: Apr 2026	
<b>WP Manager:</b> Evelyn Stynen			
<b>Participants:</b> Terradue, Brockmann Consult			
<p><b>WP Objective</b></p> <p>WP11 aims to manage the communication with the APEX user community, facilitate engagement within the broader Earth Observation (EO) community, onboard the SEF initiatives and application projects, integrate APEX-based services onto the NoR, and ensure the ongoing enhancement of APEX services through user feedback.</p> <p><b>WP Inputs:</b></p> <ul style="list-style-type: none"> <li>• D01-PMP : Project Management Plan</li> </ul> <p><b>Tasks:</b></p> <p><i>T11.1 NoR Onboarding (VITO)</i></p> <ul style="list-style-type: none"> <li>• Extend the scope of onboarding from just the Geospatial Explorer Service to include other APEX services. This involves technical integration, thorough testing, and strategic deployment of these services within the NoR framework.</li> <li>• Establish and refine a system for efficiently managing and executing incoming requests from NoR. This system should be capable of effectively addressing queries, feedback, and support requests.</li> <li>• Develop and update comprehensive documentation and training materials to assist users in navigating and utilizing the full range of onboarded APEX services within the NoR.</li> </ul> <p><i>T11.2 Project Onboarding (VITO)</i></p> <ul style="list-style-type: none"> <li>• Reassess and update the list of project candidates for onboarding based on established criteria, focusing on technical compatibility, strategic alignment, and potential impact.</li> <li>• Create and update detailed documentation outlining the procedures and requirements for onboarding projects onto APEX. This should include guidelines for technical integration and collaboration.</li> <li>• Continue to foster and manage relationships with external projects, ensuring clear communication and mutual understanding of expectations and objectives.</li> </ul>			

- Provide comprehensive support to projects during the onboarding process. This includes technical assistance, guidance on integration with APEX services, and problem resolution.

#### *T11.3 Communication (VITO)*

- Create communication materials.
- Execute the communication plan based on the project's progress.
- Participate in user events and promote the service; this includes conferences (where team members participate anyway) as well as user fora such as the SNAP forum.
- Connect with ESA application projects (through the respective TOs).
- Collect feedback from users.
- Contribute to service evolutions.
- Writing of technical blog posts.
- Writing of use-case focused blog posts.
- Coordinate training and capacity building activities.
- Organize user consultation event.

#### **WP Outputs/Results:**

##### Deliverables:

- D11-ISS: APEX Instantiation Services & Specifications
- D12-PSS: APEX Propagation Services & Specifications
- D13-COM: Communication & Outreach Report

**Total Person Hours: 1472**



8 SCHEDULE



Figure 3. APEX Project Timeline



Figure 4. APEx Gantt Chart

## 9 WORK ORDERS

As outlined in the contract and financial proposal, the APEx consortium can request additional work orders to utilise the project's LoL budget for tasks that demand more effort than initially estimated. These efforts can be requested for:

- Support for APEx Propagation Services: Assistance with enhancement and cloudification tasks, algorithm porting (openEO), and packaging (Application Package) to maximise support for strategic projects.
- APEx Communication Activities: Help in developing specific advanced graphical editing elements to enhance APEx's visual approach and identity.
- Advanced Feature Development for the APEx Geospatial Explorer: Support for integrating new and innovative user interface features to enhance the tool's capabilities.

Table 13 provides an overview of the work orders that have been requested by the project, which currently leaves the LoL budget with a remaining balance of **€ 538.012,42**. Furthermore, Table 14 includes an overview of planned WOs that are still under discussion.

*Table 13. Overview of Work Orders*

ID	Description of tasks	Budget	Estimated Delivery Date	Status
1	<ul style="list-style-type: none"> <li>• EFAST S2/S3 Fusion implementation in openEO</li> <li>• Analysis of FORCE toolbox</li> </ul>	€ 28.965,28	02/06/2025	In Implementation
2	Advanced data visualisation features for the APEx Geospatial Explorer.	€ 33.022,30	14/06/2025	In Proposal

*Table 14. Overview of Planned Work Orders*

ID	Description of tasks
3	Follow-up on advanced features for the APEx Geospatial Explorer
4	openEO-based Algorithm Porting support for ESA projects

## 10 CLOUD DEPLOYMENT STRATEGY

The cloud deployment strategy of APEx consists of two major cloud environments: the ESA Cloud and the Copernicus Data Space Ecosystem (CDSE). Each plays a crucial role in hosting the various components of the APEx services. This section describes the deployment of the APEx components and services on these different cloud environments and provides insights into cost management and how the resources will be covered through the NoR.

### 10.1 ESA Cloud

The ESA Cloud environment will host the main APEx portal and the onboarded project results. The APEx portal will use one or more web and database servers, which will host a website serving as the primary entry point for visitors. Given that the website primarily hosts static content, scalability needs are limited. Therefore, the main portal will reside directly on the available VMs within the ESA Cloud.

Project results will be stored in ESA's EOP-S Project Result Repository (PRR), which is hosted on the ESA Cloud, for long-term storage. To facilitate data usage across other cloud-based platforms, this repository must be externally accessible. A minimal requirement is to make project results available from the CDSE, ensuring accessibility from the APEx instantiated services.

When data is hosted on the ESA Cloud, accessibility through HTTP URLs is crucial, including support for a high volume of requests and low latency. To ensure optimal design, it is essential to have in-depth knowledge of the performance characteristics and capabilities of the ESA private cloud environment. Therefore, we suggest that these features be managed and operated within ESA, leveraging their expertise in storage and networking systems.

Datasets, that generate a large volume of requests or require low latency, can be mirrored on other cloud storage solutions near the processing platforms. This mirroring is a manual step that needs to be performed per collection. Automation scripts can support this step, but in general, it involves copying the data and metadata. It is important to note that the storage costs of the mirroring will need to be covered either by ESA or the processing platform.

### 10.2 Instantiation Services

#### 10.2.1 Open Telekom Cloud IaaS

APEx will develop its new services within a public cloud environment. This strategy ensures a scalable setting for the development and operation of various instantiation services requested by projects. While the primary purpose of this environment is to operate the instantiated components, it also supports propagation services linked to other APEx components, such as the intercomparison service where a web-based visualization could be requested.

For the primary APEx cloud environment, we propose leveraging the Open Telekom Cloud (OTC) IaaS offering for the following reasons:

- It is an EU-based cloud registered in ESA NoR.
- Previous experience demonstrates our ability to run an operational Kubernetes cluster on this provider.
- This provider offers an attractive set of managed services, greatly reducing the operational overhead of managing the instantiated services.
- We can reuse previous experiences.
- The pricing of this provider is competitive compared to other offerings.
- This provider also hosts CDSE, ensuring proximity to the largest collection of Copernicus data and CDSE services running on top of it.

### 10.2.2 Autoscaling Kubernetes for Instantiation Services

The key strategy for cloud deployment involves using a Kubernetes cluster that dynamically adjusts its size depending on the number of instantiation services running on it. This means that a fixed, but low, number of virtual machines is required to operate the basic Kubernetes instance in a highly available manner. When additional services are instantiated based on user requests, the cluster autoscaler will provision the necessary VMs. This ensures that cloud costs are generally proportional to the number of supported projects. All of this happens automatically, further minimizing operational costs.

Furthermore, this approach allows running multiple services on a single virtual machine. For instance, a project portal might run in a fairly small environment if it only needs to serve static pages.

### 10.2.3 Cost Management

The use of public cloud infrastructure will incur costs, which need to be transparently managed as part of project management. To facilitate this process, NoR vouchers will be requested for the selected cloud provider. Upon receipt, the cloud provider will instantiate a cloud environment with a positive credit balance that can be consumed by the APEx consortium.

The cloud provider should offer a transparent overview of the actual cloud costs incurred on a monthly basis. Additionally, the Kubernetes metrics system, Prometheus, will record resources consumed by instantiation services, such as CPU hours spent running. A Grafana dashboard will allow the consumption of specific services over a given time period, facilitating cost monitoring and management.

## 10.3 Propagation Services

The propagation services aim to maximize the usage of existing NoR platforms to support algorithm execution, upscaling, cloudification and potential enhancement. Depending on the type of propagation service, additional APEx instantiation services may be employed to support these activities. For example, the upscaling service may require a Geospatial Explorer to display the final results.

For its hosting, upscaling and cloudification service, APEx will initially focus on algorithms built using one of the initial APEx-compatible standards:

- openEO, supported through the Copernicus Data Space Ecosystem
- OGC Application Package, supported by Terradue's Ellip Solution

To support the initial development of the APEx propagation services, an estimated NoR request for both platforms is included in the next section. These resources are intended for use by the APEx project. When a project requests support for one of the APEx propagation services, APEx will act as the broker for requesting NoR resources based on the specific use case.

## 11 NETWORK OF RESOURCES

The network of resources plays a crucial role in all APEX components. This applies not only from the APEX perspective, where access to cloud-based resources is required for hosting various APEX services and components but also from the viewpoint of a project that needs access to APEX services. In this paragraph, these integrations are further highlighted.

### 11.1 Cloud Infrastructure

The cloud infrastructure requested through the NoR will need to host both the common, so-called transversal, components (e.g., log aggregation, authentication, Kubernetes management services, etc.) and all of the APEX instantiated services. While it is possible to estimate the resources needed for the transversal components, the resources for the instantiated services depend on the number of projects to support and the expected usage for each service.

Therefore, the project suggests starting with an initial NoR request to cover the base resources for hosting the transversal components and an initial set of instantiated services to demonstrate the MVP solution. This initial estimation of resources is outlined in Table 15. This approach allows the project to test the cloud environment and provide a more accurate estimation of the resources needed for each instantiation service. It will also enable APEX to test different configurations to determine the most cost-efficient setup.

Table 15. Estimates for NoR cloud resources (6 months)

Amount	Product	Price	Unit	Total	Total/Year
Relational Databases					
1	RDS MySQL D HA 2 vCPU 4 GB RAM	€ 0.21717	per hour	€ 0.22	€ 1 902.41
1	RDS PostgreSQL D HA 2 vCPU 8 GB RAM	€ 0.87507	per hour	€ 0.88	€ 7 665.61
200	RDS EVS Ultra-high I/O	€ 0.08500	per GB/month	€ 17.00	€ 204.00
1000	RDS Backup Space	€ 0.06630	per GB/month	€ 66.30	€ 795.60
Redis					
1	DCS Master Standby 0,5GB	€ 0.01069	per hour	€ 0.01	€ 93.61
Elastic Search					
1	CSS Cluster css.large.8	€ 0.18009	per hour	€ 0.18	€ 1 577.61
S3 Storage					



Amount	Product	Price	Unit	Total	Total/Year
1000	OBS Standard Space	€ 0.01430	per GB/month	€ 14.30	€ 171.60
63072	OBS Standard Requests	€ 0.00280	per 1000 requests	€ 176.29	€ 176.29
Container Platform					
1	CCE VM Cluster small (HA)	€ 0.28389	per hour	€ 0.28	€ 2 486.89
1	General Purpose s3.4xl.1 - 16vcpu / 16GB ram - Open Linux	€ 0.43952	per hour	€ 0.44	€ 3 850.18
8	General Purpose s3.2xl.2- 8vcpu / 16GB ram - Open Linux	€ 0.22599	per hour	€ 1.58	€ 15 837.45
1200	EVS High I/O	€ 0.05100	Per GB/month	€ 25.50	€ 734.40
1	Software Repository for Container	€ -	Free	€ 0.00	€ 0.00
General Infrastructure					
5	DNS Hosted Zone public	€ 0.00045	per hour	€ 0.00	€ 19.71
315.36	DNS Queries public per Million	€ 0.27540	Per million	€ 86.85	€ 86.85
1	NAT Gateway small	€ 0.11232	per hour	€ 0.11	€ 983.92
2	WAF Domain - Tier 1	€ 0.18495	per hour	€ 0.37	€ 3 240.32
<b>POC cost for 6 Months</b>					<b>€ 19 913.22</b>

The amounts detailed in Table 15 reflect the estimated cost for six months. For the entire two-year contract, this totals €80,000. Please consider this estimate as preliminary as it may vary throughout the project's duration. The project aims to continuously monitor and optimize the cloud environment to minimize costs.

Based on the initial request, the project also estimated a ceiling price for the instantiation services required over the two-year contract. This ceiling price is provisional and should not be considered final or fully accurate. The cost model will be adjusted during the project, incorporating benchmarks and actual use cases to provide more accurate figures. Table 16 shows a preliminary estimate of the costs associated with supporting the instantiated services for an average duration of one year within the two-year contract period:

Table 16. Estimated cost per APEX instantiation service

Component	Estimate cost per month	Estimated instantiations	Total
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Project Portal	€ 200	15	€ 36 000
Geospatial Explorer	€ 50	10	€ 6 000
IDE	€ 200	10	€ 24 000
Workspace	€ 200	5	€ 12 000
Catalogue	€ 150	15	€ 27 000
User Forum	€ 150	5	€ 9 000
Documentation Portal	€ 50	5	€ 3 000
<b>Total</b>			<b>€ 117 000</b>

After the two-year contract, the APEX services will be onboarded on the NoR with their own dedicated pricing models. These models will cover the cost of the cloud resources, allowing the APEX Kubernetes environment to scale with project demand.

## 11.2 Ellip Studio

The APEX Interactive Development Environment and User Workspace are key components of Terradue's existing service offering, known as "The Ellip Studio Solution". Although the evolution of these services and integration with the other APEX services and components is covered by the project budget, there is also a need to support the various project partners in their activities for this project, such as the algorithm enhancement service, where a development environment can be requested. The cost of these activities is covered by the estimates outlined in Table 17.

Table 17. NoR estimation for Ellip Studio

Resource	Amount	Duration	Price
Ellip Studio	4	4 months	44.000 EUR

## 11.3 Algorithm Hosting

APEX propagation services, including algorithm hosting and upscaling, focus on utilizing existing Network of Resources services that support openEO and OGC Application Package technologies. While the project budget covers the evolution and integration of these services, access to the existing environments for all project partners is covered by the estimations in Table 18.

Table 18. NoR estimation for Algorithm Hosting

Resource	Amount	Duration	Price
openEO Platform – Advanced / Professional License	3	24 months	36.000 EUR
openEO Platform – Gold Support	3	1 months	30.000 EUR

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Ellip – Support to Algorithm Integration	4	4 months	36.000 EUR
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## 11.4 Request Overview

Table 19 provides an overview of the NoR requests submitted to support APEX activities. During the Phase-In stage of the project, the primary focus of these requests was on the creation and deployment of APEX Instantiation Services within the OTC cloud environment. In contrast, the APEX Propagation activities did not yet necessitate dedicated NoR requests, as the required resources were either limited or adequately covered by the free tiers available on existing platforms.

*Table 19. NoR Request Overview*

ID	Status	Request	Total Amount	Expire Date	Usage
4624QI	Provisioned	Voucher for OTC Infrastructure	€19,947.00	July 2025	83%
5219jN	Provisioned	Voucher for OTC Infrastructure	€60,001.50	April 2026	0%
4c06XF	Provisioned	Testing GEP online data processing services	€17,367.50	May 2026	N.A.
4c10KA	Provisioned	Ellip Studio	€48,700.00	May 2026	N.A.
<b>Total</b>			<b>€68,647.00</b>		

## 12 PROJECT INTERACTIONS

### 12.1 EarthCODE

The EarthCODE project (<https://earthcode.esa.int/>) focuses on advancing FAIR and Open Earth System Science by leveraging existing technology and platforms. This initiative aims to foster innovation and collaboration within ESA Science projects by providing collaborative development tools, resources, community guidelines, and documentation. One of the key objectives of EarthCODE is to establish a mechanism that ensures the long-term availability and continuous updating of geophysical products developed through ESA Science Clusters.

Although EarthCODE primarily targets projects centred on generating scientific results, it shares significant conceptual and operational similarities with APEx. Both projects prioritise the long-term preservation of project outcomes and share common elements such as catalogues, algorithms, workflows, processing environments, and reusable building blocks.

Recognising this overlap, both EarthCODE and APEx have identified an opportunity for collaboration and knowledge exchange. By aligning their efforts, the projects aim to enhance support for participating initiatives and facilitate a seamless transition between the two frameworks. This collaboration could lead to several interesting potential use cases, including:

- **Transition from science to service:** Algorithms developed with EarthCODE tools and resources could be easily adapted into APEx-compatible services, thanks to conceptual and technological compatibility.
- **Integration of EarthCODE and APEx results:** By standardising the storage and processing of project results across both platforms, outcomes from EarthCODE and APEx onboarded projects could be integrated within a unified processing environment.

To further strengthen this collaboration, the APEx, EarthCODE, and EOEPKA+ consortia have established a bi-weekly meeting schedule. These meetings serve as a forum for in-depth discussions on common topics, allowing for potential alignment and the exchange of knowledge and experiences. Key discussion topics include:

- **Catalogue integration for algorithms:** Exploring the use of metadata and protocols, such as OGC Records versus STAC, to ensure algorithms can be registered in EarthCODE and APEx catalogues through a common framework.
- **Common Building Blocks:** Investigating the usage of shared components as defined by EOEPKA+.
- **Storage of project results:** Exploring and defining the architecture of the ESA Project Results Repository to benefit both initiatives.

This collaborative approach aims to improve project support and create a more integrated ecosystem, ultimately benefiting the user communities of both EarthCODE and APEx.

## 12.2 EOEPKA+

EOEPKA+ (<https://eoePCA.org/>) aims to enhance interoperability by developing a complementary set of innovative Building Blocks (BB). These Building Blocks utilise open-source technologies from initiatives such as OpenEO, EOEPKA, and Pangeo. By using standardised geospatial interfaces and open standards, EOEPKA+ seeks to consolidate and harmonise a federated EO cloud and platform offering that can support common use cases within the EO Science, Research and Development (R&D), and applications communities. The central objective of EOEPKA+ is to "bring the user to the data" by moving user exploitation to hosted environments with co-located computing and storage.

EOEPKA+'s emphasis on open standards and the reuse of existing cloud-based platforms aligns closely with the goals of APEx. As EOEPKA+ focuses on defining Building Blocks across EO projects, APEx sees great value in establishing bidirectional communication between the two initiatives. This collaboration ensures that APEx can leverage Building Blocks, thereby maximising interoperability. Additionally, it also allows APEx to provide direct feedback on the usage and definition of these Building Blocks, benefiting not only both projects but also other initiatives interested in integrating existing Building Blocks or becoming APEx-compliant algorithm hosting platforms.

The collaboration between EOEPKA+ and APEx is supported through two key channels. Firstly, both VITO and Terradue are actively involved in both projects, facilitating the exchange of knowledge and experience. Terradue, with its extensive participation in EOEPKA initiatives, has a comprehensive understanding of the existing Building Blocks and their future development, ensuring alignment between EOEPKA+ and APEx. Secondly, APEx maintains a dedicated bi-weekly meeting with the EarthCODE and EOEPKA teams to align on common concepts and technologies. Further details on this collaboration can be found in the previous section.

As part of the collaboration with EOEPKA+, APEx has focused efforts on analysing the usage of the following Building Blocks:

- **Resource Health:** Initial discussions have been held to align the implementation of this Building Block with APEx's approach. Due to differing project timelines, APEx has already implemented an approach that will be further harmonised throughout the project. The team aims to use this building block to monitor the health of both APEx components, including both core and instantiated services and onboarded algorithms.
- **Application Quality:** APEx has contributed to discussions regarding the Application Quality Building Block, providing insights on how openEO- and EOAP-based implementations can be assessed for quality.
- **IAM:** Discussions have been held to exchange ideas on utilising Keycloak and other components to support the overall management of roles and permissions. This

functionality is crucial within APEX, enabling project administrators to manage access to project working environments for their members in a self-service manner.

- **Workspace:** Initial communication will be established to further investigate the integration of the Workspace Building Block into APEX. This integration will enhance project capabilities regarding data management and sharing options.

## 12.3 Stakeholder Engagement Facility

The Stakeholder Engagement Facility (SEF; <https://esa-sef.eu/>), funded by ESA, aims to expand stakeholder engagement for projects supported through the Applications Element of the Science for Society programme. The SEF's primary role is to implement a systematic knowledge and capacity-sharing service across various ESA-funded Applications projects, enhancing and extending engagement with diverse stakeholder communities through tailored approaches.

Collaboration between SEF and APEX is both logical and beneficial on multiple fronts. Firstly, both initiatives target similar types of projects. Secondly, the services provided by each project are highly complementary. While APEX offers technical and conceptual support to help projects create their results and ensure long-term availability, SEF focuses on engaging stakeholders and promoting the reuse of these results within the broader community. SEF is therefore considered crucial for the successful uptake of the project outcomes onboarded onto APEX.

Throughout the APEX project, the consortium will support SEF activities by offering instantiation and propagation services. APEX will ensure that application algorithms remain available as on-demand services and will provide the necessary tools and services to facilitate knowledge sharing and management.

### 12.3.1 User Categories

APEX offers a comprehensive suite of services that significantly enhances SEF's ability to engage stakeholders, improve decision-making support, ensure operational efficiency, and promote sustainable impact. The value proposition of APEX to SEF can be articulated through three defined user categories: Data Visualization/Exploration Users, Data Analytics Users, and Data Processing Users. Each category benefits from APEX's tailored services, ensuring SEF can effectively engage a broad spectrum of stakeholders.

#### Data Visualization / Exploration Users

This user group is mainly interested in exploring EO data, primarily through visualising datasets and enabling interactive exploration. These features are designed to spark interest and introduce users to the available datasets.

Users in this category can possess a wide range of expertise, both thematically and technically. Given the focus on data exploration, the solution should provide a user-friendly and intuitive interface catering to the skill levels of the users. While some EO datasets may

require more thematic knowledge to fully understand their purpose, the solution should also offer contextual information, enabling users to easily comprehend what is being visualised.

The APEx Geospatial Explorer service largely supports this user category. It provides an interactive visualisation of EO data (both raster and vector), allowing users to explore data and perform basic interactions. These interactions may include visualising multiple layers on a map, displaying charts with pre-calculated data, engaging with curated storytelling, and exploring data over time.

### **Data Analytics Users**

Users who find an EO dataset of interest, either through prior experience or as a Data Visualization/Exploration User, may wish to perform their own analytics on the dataset. This could include executing custom statistical analyses and manipulating data to extract meaningful insights.

This category of users is typically more experienced, possessing both basic to advanced thematic and technical expertise. Understanding the data being analysed requires a solid foundation in EO data, as well as technical knowledge of how to process and analyse common EO data formats. These users are often familiar with programming languages like Python and R and tools such as Jupyter Notebooks and QGIS.

APEx can support these users through the Interactive Development Environment (IDE) and User Workspace services. The IDE provides an online coding environment, offering both cloud resources and necessary tools for processing and analysing EO datasets. The User Workspace complements this by providing a centralised space for storing results and facilitating collaboration with others.

### **Data Processing Users**

The final category comprises data processing users, who aim to use existing algorithms or workflows to generate their own products using a cloud processing platform. This differs from data analytics, as these users intend to create entirely new datasets. This could be useful when existing datasets are limited in geographical or temporal extent or when specific parameters need adjustment.

These users are considered the most advanced, requiring not only a deep understanding of the data but also of the underlying algorithms and technical expertise to execute them. APEx supports these users by providing access to the tools needed to execute algorithms, as well as ensuring these algorithms adhere to interoperability standards that allow for consistent and user-friendly execution. The APEx IDE and User Workspace services offer a cloud-based environment that includes the necessary tools and storage for data processing activities and fosters collaboration.

Additionally, through its Interoperability and Compliance guidelines, APEx ensures that onboarded algorithms can easily be executed via openEO or as Application Packages. Both



technologies offer a wide range of tools that support algorithm execution on existing cloud platforms optimised for large-scale data processing.

## 12.4 Other ESA Projects/Initiatives

The APEx consortium is actively engaging with other ESA projects to explore how these projects can be supported through APEx's instantiation and propagation services. Table 20 provides an overview of the projects with which APEx is currently collaborating. This list is also actively managed on GitHub at <https://github.com/orgs/ESA-APEx/projects/4>.

Table 20. Interactions with ESA projects

Project	Contractor	Description	Contact Person	Reference	APEx services
AI4FOOD	VITO	Improve implementation of MOGPR.	<a href="mailto:bram.janssen@vito.be">bram.janssen@vito.be</a>	<a href="https://github.com/Open-EO/FuseTS">https://github.com/Open-EO/FuseTS</a>	Algorithm Enhancement
ANIN	GMV	South Africa Drought Monitoring Service aims to increase the awareness of EO data potential to support the operation of added-value services in the field of drought monitoring decision making. The project aims to build a drought early warning system that is based on the continuous calculation of a set of satellite-based indices and indicators.	<a href="mailto:jusuares@gmv.com">jusuares@gmv.com</a>	<a href="https://eoafrika.drought-za.org/">https://eoafrika.drought-za.org/</a>	Data Onboarding

Project	Contractor	Description	Contact Person	Reference	APEx services
CRISP	sarmap	CRISP project aims to address Indicator SDG 2.4.1, which measures the proportion of agricultural land under productive and sustainable agriculture. In collaboration with an heterogenous group of Early Adopters (EAs), CRISP will contribute to achieve the target set for 2030, which involves ensuring sustainable food production systems and implementing resilient agricultural practices.	goriggi@sarmap.ch	<a href="https://crisp.sarmap.ch/">https://crisp.sarmap.ch/</a>	Data Onboarding Algorithm Porting
EFAST	DHI	The EFAST S2/S3 fusion algorithm is implemented with SNAP pre-processing and the spatio-temporal fusion step. Aim is to apply it to Africa. Optimisation is required for at least the pre-processing part. Implementation as	<a href="mailto:mimu@dhigroup.com">mimu@dhigroup.com</a>	<a href="https://github.com/DHI-GRAS/efast">https://github.com/DHI-GRAS/efast</a>	Algorithm Enhancement

Project	Contractor	Description	Contact Person	Reference	APEX services
		openEO UDP to be considered.			
FORCE	Open Source	FORCE is an all-in-one processing engine for medium-resolution Earth Observation image archives. FORCE uses the data cube concept to mass-generate Analysis Ready Data and enables large area + time series applications. With FORCE, you can perform all essential tasks in a typical Earth Observation Analysis workflow, i.e. going from data to information.	david.frantz@uni-trier.de	<a href="https://github.com/davidfrantz/force">https://github.com/davidfrantz/force</a>	Toolbox Cloudification
Forest Carbon Monitoring	VTT	The Forest Carbon Monitoring project is developing and implementing a set of tools for reliable and cost-efficient monitoring of forest carbon stock based on satellite remote sensing	Jukka.Miettinen@vtt.fi	<a href="https://www.forestcarbonplatform.org/">https://www.forestcarbonplatform.org/</a>	Data Onboarding

Project	Contractor	Description	Contact Person	Reference	APEX services
		approaches supported by in-situ datasets.			
Global Development Assistance (GDA)	GMV	Currently using the CCDC implementation of GEE, but there is not much consistency in the costs and the implementation is not open. Interested to implement the algorithm in an open source technology and see how it can be improved.	<a href="mailto:cdomenech@gmv.com">cdomenech@gmv.com</a> <a href="mailto:alex.chunet@esa.int">alex.chunet@esa.int</a> <a href="mailto:clement.albergel@esa.int">clement.albergel@esa.int</a>	<a href="https://gda.esa.int/">https://gda.esa.int/</a>	Algorithm Upscaling, Algorithm Enhancement
GTIF – Wind Turbine Detection	DHI	Onboarding of the wind turbine detection algorithm.	<a href="mailto:kegr@dhigroup.com">kegr@dhigroup.com</a>		Algorithm Onboarding, Algorithm Enhancement
Open SAR Toolkit (OST)	ESA	Open SAR Toolkit is wrapping several SAR processing chains of SNAP and the retrieval of respective input data into an application. Aim is to provide selected workflows as APEX registered service. Deployment as	james.wheeler@solenix.ch	<a href="https://gitlab.esa.int/ai4eo/esa-philab.git">https://gitlab.esa.int/ai4eo/esa-philab.git</a>	Toolbox Cloudification

Project	Contractor	Description	Contact Person	Reference	APEx services
		application package to be considered			
PEOPLE-EA	VITO	The main objective of the PEOPLE-EA is to study the relevance of Earth observations for SEEA compliant ecosystem accounting and to demonstrate its use for terrestrial and freshwater ecosystems.	bruno.smets@vito.be	<a href="https://esa-people-ea.org/en">https://esa-people-ea.org/en</a>	Data Onboarding
PEOPLE-Ecoschemes	GISAT	Integration of their project results into the SEF Geospatial Explorer. The algorithm porting and onboarding can also be considered after an initial analysis of the project workflows.	jan.misurec@gisat.cz	<a href="https://esa-people-eoschemes.info/">https://esa-people-eoschemes.info/</a>	Algorithm Porting, Algorithm Onboarding, Data Onboarding
SEN4CAP	ESA	Integration of the SEN4CAP results in the SEF Geospatial Explorer. Additionally it is expected that the workflows from the open	<a href="mailto:patrick.griffiths@esa.int">patrick.griffiths@esa.int</a>		Algorithm Onboarding, Algorithm Porting

Project	Contractor	Description	Contact Person	Reference	APEX services
		ITT will be onboarded onto APEX.			
SEN4LDN	VITO	High resolution Land Degradation Neutrality Monitoring - develop, demonstrate and validate robust automated Earth Observation methods to increase the spatial details of national assessments of land degradation and SDG indicator 15.3.1.	<a href="mailto:ruben.vandekerchove@vito.be">ruben.vandekerchove@vito.be</a>	<a href="https://esa-sen4ldn.org/en">https://esa-sen4ldn.org/en</a>	Algorithm Porting, Algorithm Onboarding
SEN4STAT	UCL	The objective of the Sen4Stat project is to facilitate the uptake of EO information by the NSOs supporting the agricultural statistics. Special attention is given developing and demonstrating EO products and best practices for agriculture monitoring relevant for SDG reporting and to	<a href="mailto:Sophie.Bontemps@uclouvain.be">Sophie.Bontemps@uclouvain.be</a>	<a href="https://www.esa-sen4stat.org/">https://www.esa-sen4stat.org/</a>	Data Onboarding

Project	Contractor	Description	Contact Person	Reference	APEx services
		monitor their progress at national scale.			
WaSCIA	Telespazio	Water Stress and Climate Indices for Africa (WaSCIA) is a European Space Agency funded project that aims to deliver high-quality Water Stress and Climate Indices through an easy-to-use web interface to help the management of drought and water stress in Africa.	<a href="mailto:erlinda.biescas@telespazio.com">erlinda.biescas@telespazio.com</a>	<a href="https://wascia.ssl.telespazio.com/">https://wascia.ssl.telespazio.com/</a>	Data Onboarding
WorldCereal	VITO	On demand mapping of Cereals	<a href="mailto:jeroen.dries@vito.be">jeroen.dries@vito.be</a>	<a href="https://esa-worldcereal.org/en">https://esa-worldcereal.org/en</a>	Algorithm Onboarding, Data Onboarding



Project	Contractor	Description	Contact Person	Reference	APEX services
World Ecosystem Extent Dynamics (WEED)	VITO	Develop a globally applicable open-source toolkit for a comprehensive mapping of the extent and distribution of ecosystem types, according to different ecosystem typologies, and for monitoring the temporal variations in ecosystem extent.	<a href="mailto:bruno.smets@vito.be">bruno.smets@vito.be</a>		Project Portal, Documentation Portal, User Forum  Algorithm Porting, Algorithm Onboarding, Algorithm Upscaling, Algorithm Enhancement, Data Onboarding
WORLDISOILS	GMV	They have a workflow for measuring soil organic carbon. The full workflow or components of it could be interesting to be onboarded onto APEX as compatible algorithms. Additionally, they currently experience challenges with scaling the workflow to other geographical extents due the dedicated training of a ML model. This could be	<a href="mailto:anke.schickling@esa.int">anke.schickling@esa.int</a>	<a href="https://world-soils.com/">https://world-soils.com/</a>	Algorithm Porting, Algorithm Onboarding, Algorithm Upscaling Data Onboarding

Project	Contractor	Description	Contact Person	Reference	APEx services
		considered as an enhancement.			

## 13 RESOURCES

Table 21 provides an overview of the project management tools utilized throughout the APEX project, providing an overview of key activities and progress tracking:

*Table 21. Project management tools*

Title	Description	URL
Project Management Overview	This document provides an overview of the main project management activities, including planning, deliverable status, and action item tracking.	<a href="#">APEX Project Management.xlsx</a>
Project Progress	A GitHub project board to track the evolution of the different APEX services.	<a href="https://github.com/orgs/ESA-APEX/projects/2/views/6">https://github.com/orgs/ESA-APEX/projects/2/views/6</a>
Project Interactions	A GitHub project board to monitor interactions between APEX and ESA projects, offering a centralized view of ongoing collaborations.	<a href="https://github.com/orgs/ESA-APEX/projects/4">https://github.com/orgs/ESA-APEX/projects/4</a>
Geospatial Explorer	A GitHub project board dedicated to tracking dataset and feature integration into the Geospatial Explorer.	<a href="https://github.com/orgs/ESA-APEX/projects/3">https://github.com/orgs/ESA-APEX/projects/3</a>
Algorithm Onboarding Candidates	A GitHub project view to track the progress of candidates for onboarding algorithms into an APEX-compliant hosting platform and the APEX Algorithm Services Catalogue.	<a href="https://github.com/orgs/ESA-APEX/projects/4/views/10">https://github.com/orgs/ESA-APEX/projects/4/views/10</a>
Algorithm Porting Candidates	A GitHub project view to track the progress of candidates for algorithm porting and packaging.	<a href="https://github.com/orgs/ESA-APEX/projects/4/views/23">https://github.com/orgs/ESA-APEX/projects/4/views/23</a>
Algorithm Enhancement Candidates	A GitHub project view to track the progress of candidates for algorithm enhancement.	<a href="https://github.com/orgs/ESA-APEX/projects/4/views/19">https://github.com/orgs/ESA-APEX/projects/4/views/19</a>

Toolbox Cloudification Candidates	A GitHub project view to track the progress of candidates for toolbox cloudification.	<a href="https://github.com/orgs/ESA-APEx/projects/4/views/21">https://github.com/orgs/ESA-APEx/projects/4/views/21</a>
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